Smart Work Zone Training

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Bureau of Traffic Operations

Fall 2024

Housekeeping

- Silence all phones
- Emergency Exits
- Course Evaluation
- Quiz for PDH's
- Periodic Breaks

Overview

- What is a Smart Work Zone?
- Basic Queue Warning System with Activity
- Queue Warning System/Travel Time System with Activity
- Dynamic Late Merge System with Activity
- Digital Speed Reduction System with Activity
- Wrap-Up

Groups for Activities

- Determine groups

Work Zone Crashes

Year	Total
2019	2,473
2020	1,794
2021	2,172
2022	2,013
2023	2,168
Total	**10,620**

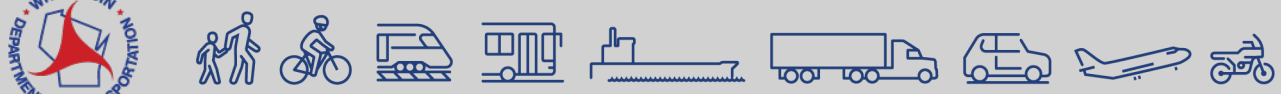
2024 Year to Date Crashes (Preliminary – January to August 2024)	**1,400**

Rear-End Crash Statistics

YEAR	R IH	U IH	Total
2017	300	411	711
2018	378	426	804
2019	271	174	445
Total	**949**	**1011**	**1960**
2020	91	61	152
2021	70	72	142
2022	85	99	184
Total	**246**	**232**	**478**
Reduction in Rear End Crashes	74%	77%	76%

What is a Smart Work Zone??

- What is a smart work zone?
  - A system that provides motorists with reliable, real-time information about upcoming traffic conditions in the work zone.
- When do you use a smart work zone?
  - Anticipated queueing on high-speed roadways
  - Queueing is not expected on high-speed roadways
- What are the benefits?
  - Queue Warning Systems: Reduce end of queue crashes by up to 45%
  - Dynamic Late Merge System: Increase in overall throughput, lane utilization, reduction in max queue, uniformly distributed speeds
  - Possible diversion



Types of Smart Work Zones

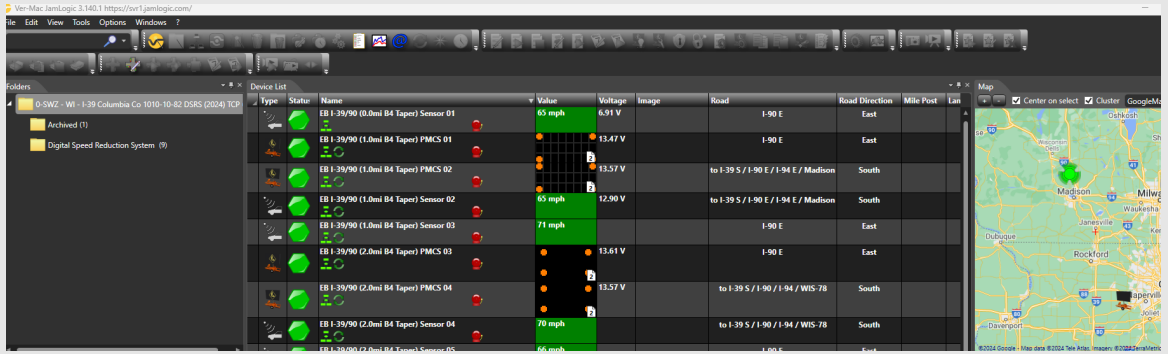
- Basic Queue Warning System (BQWS)
  - Components: Flashing Beacon Signs (FBS), Portable Traffic Sensor (PTS), Automated System Manager (ASM)
- Portable Automated Real-Time Queue Warning System (QWS)
  - Components: Portable Changeable Message Sign (PCMS), PTS, ASM
- Dynamic Late Merge System (DLMS)/Zipper Merge
  - Components: FBS, PCMS, PTS, ASM
- Travel Time Systems
  - Components: PTS, Probe Data, PCMS, DMS, ASM

Smart Work Zone Components

- Portable Traffic Sensors (PTS)
  - BQWS and QWS - placed in the advance warning area on the arrow board and then every 1 mile upstream to capture vehicle speeds
  - DLMS – placed in the advance warning area on the arrow board and on the PCMS 3,100 feet upstream of arrow board and then every 1 mile upstream to capture vehicle speeds
- Flashing Beacon Sign (FBS)
  - BQWS and DLMS - typically placed every 1 mile upstream of lane closure taper

Smart Work Zone Components

- Portable Changeable Message Signs (PCMS)
  - QWS – typically placed every 1 mile upstream of lane closure taper
  - DLMS – two in the advance warning area and one upstream of max queue
- Automated System Manager (ASM)
  - All smart work zones - stores the data and turns the system on/off based on algorithms and speed thresholds.
- Probe Data
  - Travel Time System
- Dynamic Message Signs



Number of Days and Payment

- Make sure to include the total number of days, regardless of lane closures present
  - Ex: The department will pay for the smart work zone on weekends when the lane closure is not active
- There are added benefits to having the system when there is not a lane closure
- Leaving the system operational 24/7 then does not require additional calibration from the smart work zone vendor when it is turned on and off

Miscellaneous Quantities

- Smart work zone quantities should have their **OWN** MQ'S table
  - Do not lump them in with the rest of the Traffic Control BID Items
  - Include the number of components in the MQ's table

PORTABLE AUTOMATED REAL-TIME TRAFFIC QUEUE WARNING SYSTEM (QWS ITEM 643.1200.S)

Location	Stage	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	PORTABLE TRAFFIC SENSORS (PTS)	QUEUE WARNING SYSTEM (DAY)
I 39/90/94 WB	1	6	3	55
I 39/90/94 WB	2	6	3	74
I 39/90/94 EB	1	6	3	55
I 39/90/94 EB	2	6	3	74

Includes Location, Stage, Components and Total Number of Days

BASIC QUEUE TRAFFIC WARNING SYSTEM

Location	Stage	643.1205.S BASIC QUEUE TRAFFIC WARNING SYSTEM DAY
PROJECT 1166-01-84		
CATEGORY 0010		
USH 51 SB	1	28
USH 51 NB	2	28
USH 51 NB	5	6
PROJECT 1166-01-84 TOTALS		62

Missing components – PTS, FBS, PCMS

BOARDS, AND SIGNS CONTINUED

ROADWAY	643.0900 TRAFFIC CONTROL SIGNS DAY	643.1050 TRAFFIC CONTROL PCMS DAY	643.1205.S BASIC TRAFFIC QUEUE WARNING SYSTEM DAY	643.1500 TRAFFIC CONTROL SPEED RADAR TRAILER DAY
IH 39 PRE WARNING				
WB	--	7		
EB	--	7		
IH 39 WB - STAGE 1A				
DOUBLE LANE CLOSURE	62	2	2	12
SINGLE LANE CLOSURE	27	1	15	6
SHOULDER CLOSURE	16	--	--	--
IH 39 WB - STAGE 1B				
DOUBLE LANE CLOSURE	93	3	3	18
SINGLE LANE CLOSURE	27	1	15	6
SHOULDER CLOSURE	16	--	--	--

Missing components – PTS, FBS, PCMS and need to be in own table

How do the systems work?

- Free Flow Condition
  - Speeds 40 mph or greater – the system should not be on
- Congested Condition
  - Speeds 39 mph or less – the system should turn on
  - Different messages depending on smart work zone
- Speeds
  - 1 minute in slow state – system should turn on
  - Rolling average to get out of congested condition, this is the avoid the system turning on and off in a short time frame

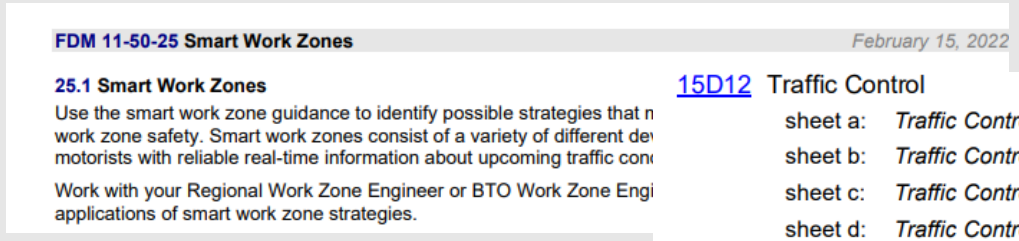
- Why do we install smart work zones on projects?
  - Reduce end of queue crashes
  - Reduce the severity of end of queue crashes
  - Allow drivers the option to take an alternate route when there are delays
  - Reduce queue lengths
  - Provide drivers information about how long they will be delayed
- When do you think we should be installing smart work zones on projects?
  - Projects on the interstate
  - High Speed Roadways
  - Projects with or without anticipated queue
  - Projects with viable alternate routes

FDM 11-50-25 Guidance

- FDM 11-50-25: https://wisconsindot.gov/rdwy/fdm/fd-11-50.pdf#fd11-50
- Provides background and recommendations for when to install the different types of smart work zones
- Not all smart work zones are a one size fits all
- Provides requirement for end of queue detection for interstates/expressways with lane closures longer than 4 weeks, regardless of queueing:
  - AADT **between 20,000 vehicles per day (vpd) and 25,000 vpd**, projects should consider installing a BQWS
  - AADT is **greater than 25,000 vpd**, projects **shall install** a BQWS

Smart Work Zone Standards

- SDD 15D12
- STSP
  - 643-040: Dynamic Late Merge System, Ite
  - 643-045: Portable Automated Real-Time Traffic Queue Warning System, Item 643.1200.S
  - 643-046: Basic Traffic Queue Warning System, Item 643.1205.S
  - 643-0XX: Digital Speed Reduction System (adding early 2025)
- SPV's



FDM 11-50-25 Smart Work Zones *February 15, 2022*

25.1 Smart Work Zones

Use the smart work zone guidance to identify possible strategies that n
work zone safety. Smart work zones consist of a variety of different de
motorists with reliable real-time information about upcoming traffic con

Work with your Regional Work Zone Engineer or BTO Work Zone Engi
applications of smart work zone strategies.

15D12 Traffic Control

sheet a:	*Traffic Control, Lane Closure*
sheet b:	*Traffic Control, Lane Closure, Speed Reduction*
sheet c:	*Traffic Control, Lane Closure, Dynamic Late Merge System*
sheet d:	*Traffic Control, Lane Closure, Basic Traffic Queue Warning System*
sheet e:	*Traffic Control, Lane Closure, Traffic Queue Warning System*
sheet f:	*Traffic Control, Lane Closure, With Temporary Rumble Strips*

STSP

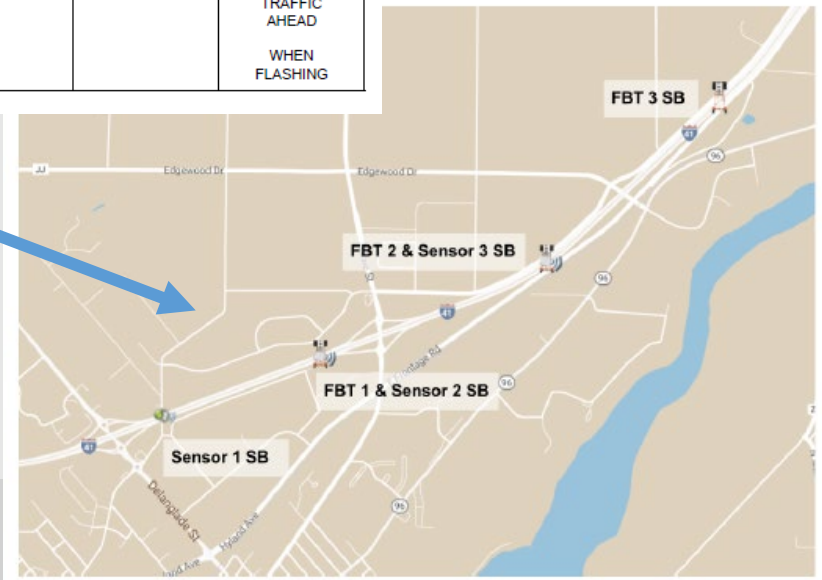
- https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrces/contracts/stsp/stspart.pdf
- STSP covers **REPOSITIONING** the FBS with the lane closure taper
  - Make the contractor move the FBS, PCMS and PTS
- STSP covers deduction for system deficiency
  - DO NOT PAY for a system that is not working
  - If a device gets hit and the rest of the system is working, pay for the system
  - If a device is not working because of the contractor, do not pay for the system

Construction Submittal Approval

- Send plan to Bureau of Traffic Operations: DOTBTOworkzone@dot.wi.gov
- Table showing the logic of the system
  - Documents the sensors that turn on the FBS
- Include a map of the location of the PTS and FBS
  - Could be an overview like shown or a link to a map

Message Logic

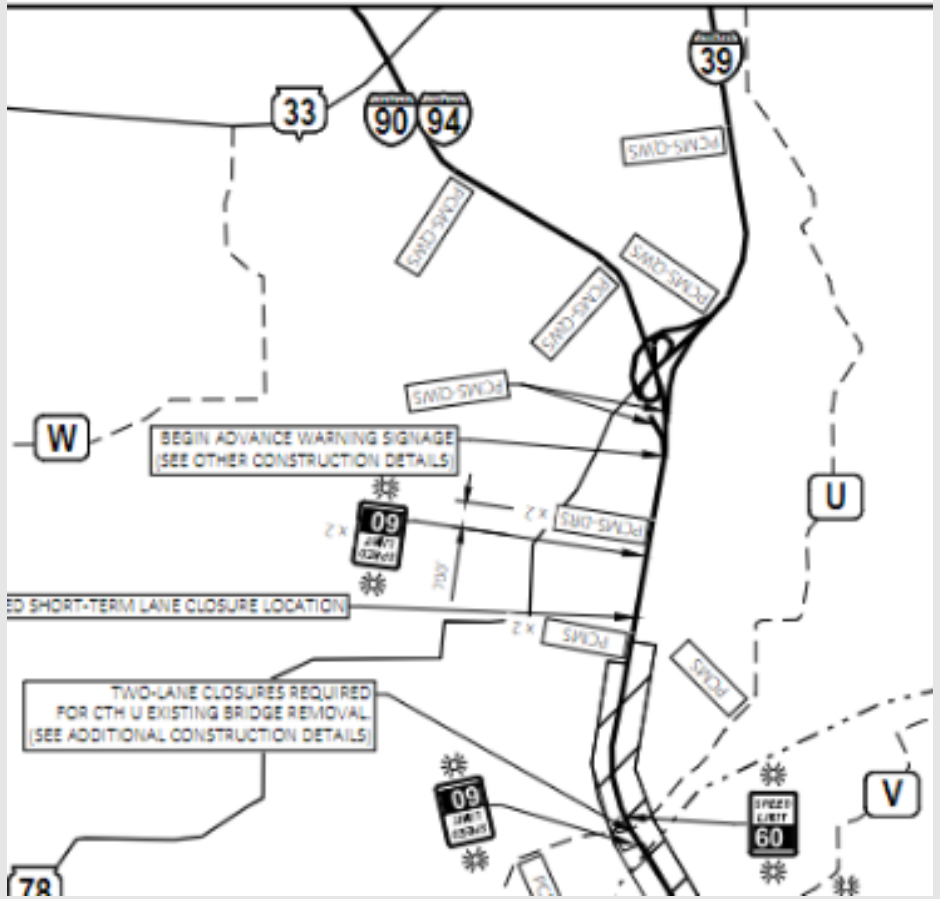
	Sensor Number(s) Referenced by Logic	Free Flow Condition Downstream Sensor > 40 MPH (BEACONS OFF)	Slow Traffic Condition Downstream Sensor < 40 MPH (BEACONS ON)
FBS 1	1,2		STOPPED OR SLOW TRAFFIC AHEAD WHEN FLASHING
FBS 2	2,3		STOPPED OR SLOW TRAFFIC AHEAD WHEN FLASHING
FBS 3	3		STOPPED OR SLOW TRAFFIC AHEAD WHEN FLASHING



Southbound I-41

Recommendations for ***Designers***

- Review the FDM for MQ's and requirements
- Select Smart Work Zone from WisTMP, Section 4 Strategy List
- Contact the regional work zone engineer or BTO for questions
- Layout the smart work zones on your plans, call out the locations for the FBS, PCMS and PTS to make it clear for the contractor and to get the correct quantities in the plan
  - Google Maps or Overview is fine

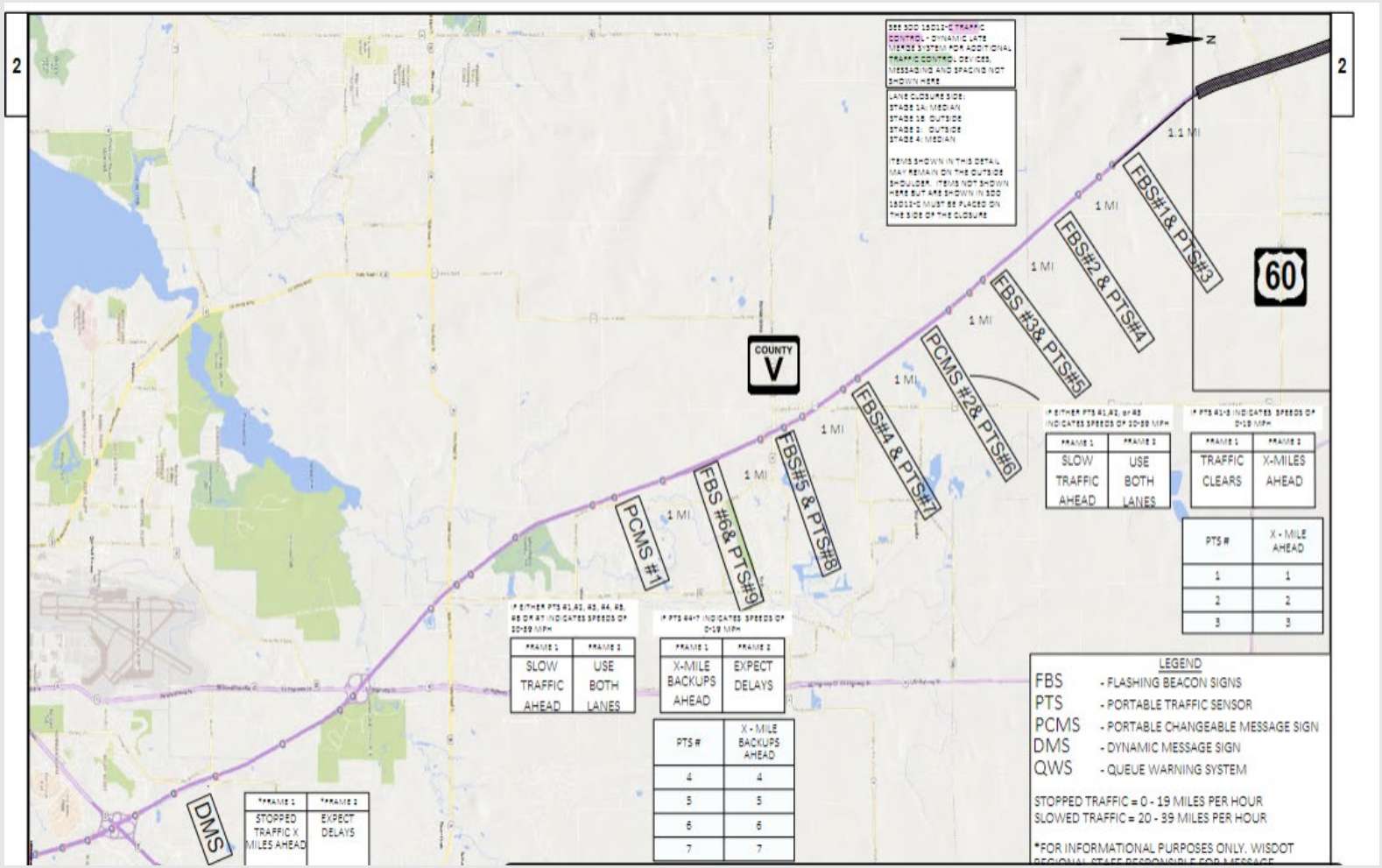


Recommendations for ***Designers***

- Consider adding two BQWS if it is a long project; talk with your Regional Work Zone Engineer
  - Ex. 11 mile project, with the potential for two active work areas
- Quantity – per system, per direction
  - PTS, PCMS, FBS, ASM all included in the system
  - Include total number of days for the system, regardless of lane closure schedule
- Consider shoulder width for placement of FBS
  - If you can't get FBS/PCMS on both sides of roadway due to shoulder width, could space the FBS/PCMS differently to have them spaced every ½ mile.

Example Plan with Tweaks

- Not a one size fits all for smart work zones



Recommendations for ***Construction***

- Make sure accounts are created for the project team and BTO
- 5 drum delineation for all devices
- Ensure you get weekly reporting or alerts
- Review placement of devices, tips below:
  - Avoid placement in on/off ramp gores
  - Place FBS/PCMS upstream of off-ramps to allow motorists to exit if stopped/slow traffic
- Check Sign Size/Font Size on FBS
  - WO8-76

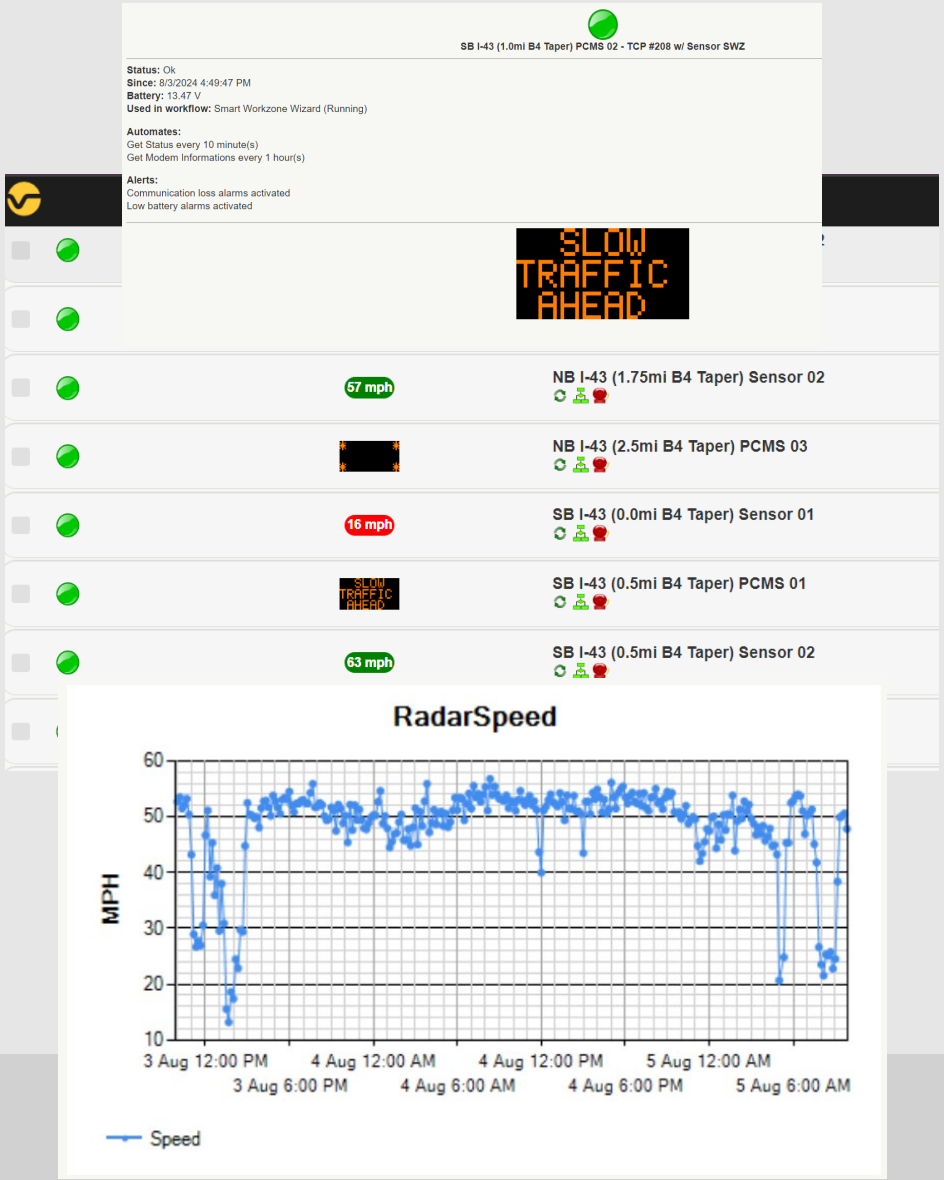
Recommendations for *Construction*

- Check system activations
  - Confirm the system turns on when speeds are 39 mph and below
  - Confirm the system turns off when speeds are 40 mph and above
  - Drive through during congestion periods
- Smart Work Zone needs to move with the lane closure taper
  - Contractor can install two systems without pay
  - Contractor can set drums from the start of the BQWS to the work area instead of moving BQWS

End of Queue Crash – smart work zone was not moved with the lane closure. The crash could have been prevented

Website Overview

- Jam Logic:
  - Mobile Version https://svr1.jamlogic.com/Mobile
  - Jam Logic Application
    - small tools request from BITS for WisDOT employees
  - One login for all smart work zones
- Qlynx:
  - Mobile Version: https://s2.qlynx.systems/PDPWI20/WebAdmin/logon.aspx
  - Different login for each smart work zone



Basic Queue Warning System (BQWS)

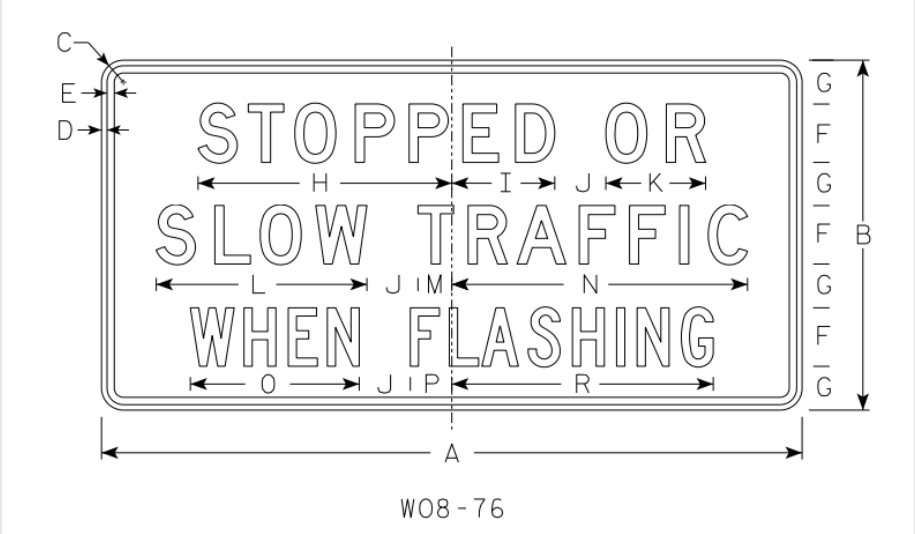
- When to use a BQWS?
  - If another Smart Work Zone System is not being used on projects lasting longer than 4 weeks, regardless of queueing or lane closures:
    - Consider installing BQWS on projects with AADT 20,000-25,000
    - Install BQWS if AADT is greater than 25,000
  - Consider installing BQWS in work zones with history of incidents or with complex geometries such as bi-directional traffic or split lane configurations
  - If the roadway has more than 2 lanes or has a high truck percentage (greater than 20% trucks), place the FBS on both sides of the roadway.

BQWS Design

- Flashing Beacon Sign – placed every 1 mile upstream of lane closure taper
  - Standard: Always covers 2-3 miles of potential queueing
  - Number of FBS is either 3 or 6 depending on number of lanes and truck %
    - 2 lanes = 3 FBS placed on the right shoulder
    - 3 lanes or greater = 6 FBS placed on both sides of the roadway
    - Greater than 20% trucks = 6 FBS placed on both sides of the roadway
- Consider adding two BQWS if it is a long project; talk with your Regional Work Zone Engineer
  - Ex. 10+ mile work zone with the potential for two active work areas

BQWS FBS

- Sign Size: 96”x48”
- Font
  - 2 different sizes
  - Line 1 & 2 = Series D
  - Line 3 = Series C



NOTES

1. Sign is Type II - Type F Reflective
2. Color:
   Background - Orange
   Message - Black
3. Message Series - Lines 1 and 2 are series D
   Line 3 is series C
4. Corners may be square or rounded when base material is plywood but borders shall be rounded as shown. When base material is metal, the corners and borders shall be rounded.

Sign is too small

Basic Queue Warning System (BQWS)

- Make sure to break out the table and include all components so the contractor knows the number of devices

BASIC TRAFFIC QUEUE WARNING SYSTEM (QWS ITEM 643.1205.S)				
Location	Stage	FLASHING BEACON SIGNS (FBS)	PORTABLE TRAFFIC SENSORS (PTS)	BASIC QUEUE WARNING SYSTEM (DAY)
IH 41 NB	3	6	3	150
IH 41 SB	3	6	3	150
* These items are part of the QWS and are paid for one complete system per roadway				

Ex: IH 41 has 3 lanes in each direction, therefore requiring FBS on both sides of the roadway.

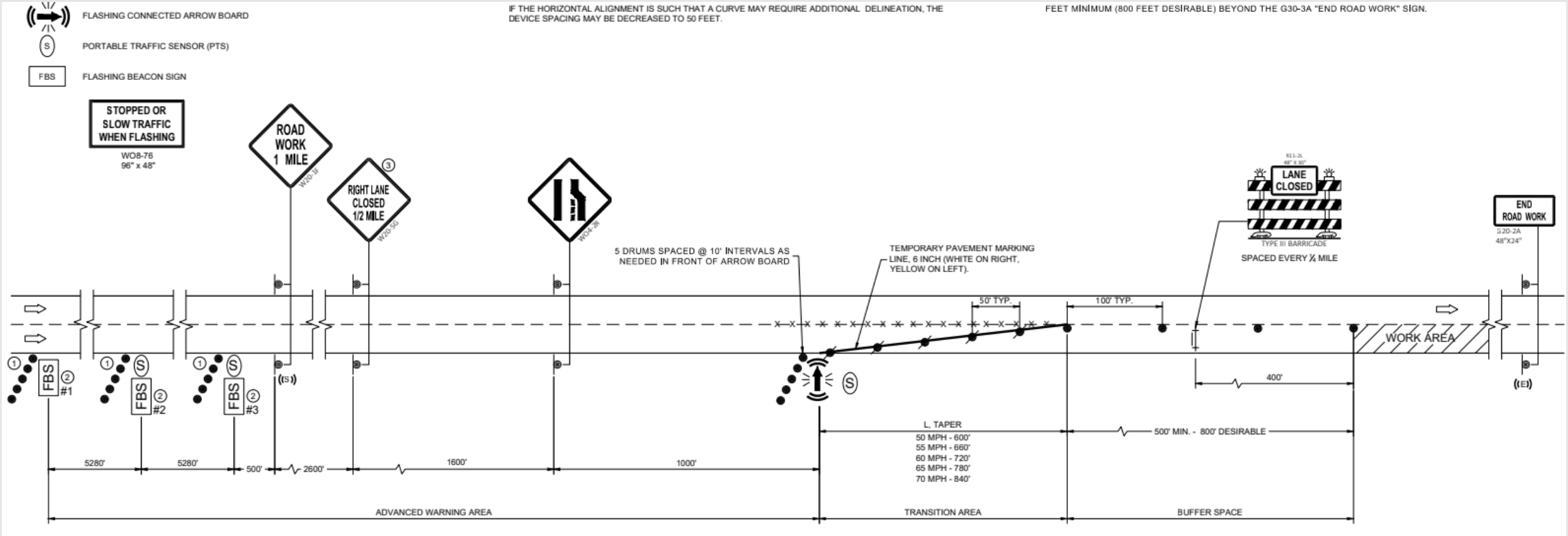
BASIC TRAFFIC QUEUE WARNING SYSTEM (QWS ITEM 643.1205.S)				
Location	Stage	FLASHING BEACON SIGNS (FBS)	PORTABLE TRAFFIC SENSORS (PTS)	BASIC QUEUE WARNING SYSTEM (DAY)
IH 94 EB	3	3	3	150
IH 94 WB	3	3	3	150
* These items are part of the QWS and are paid for one complete system per roadway				

Ex: IH 94 has 2 lanes in each direction, therefore requiring FBS on only one side of the roadway.

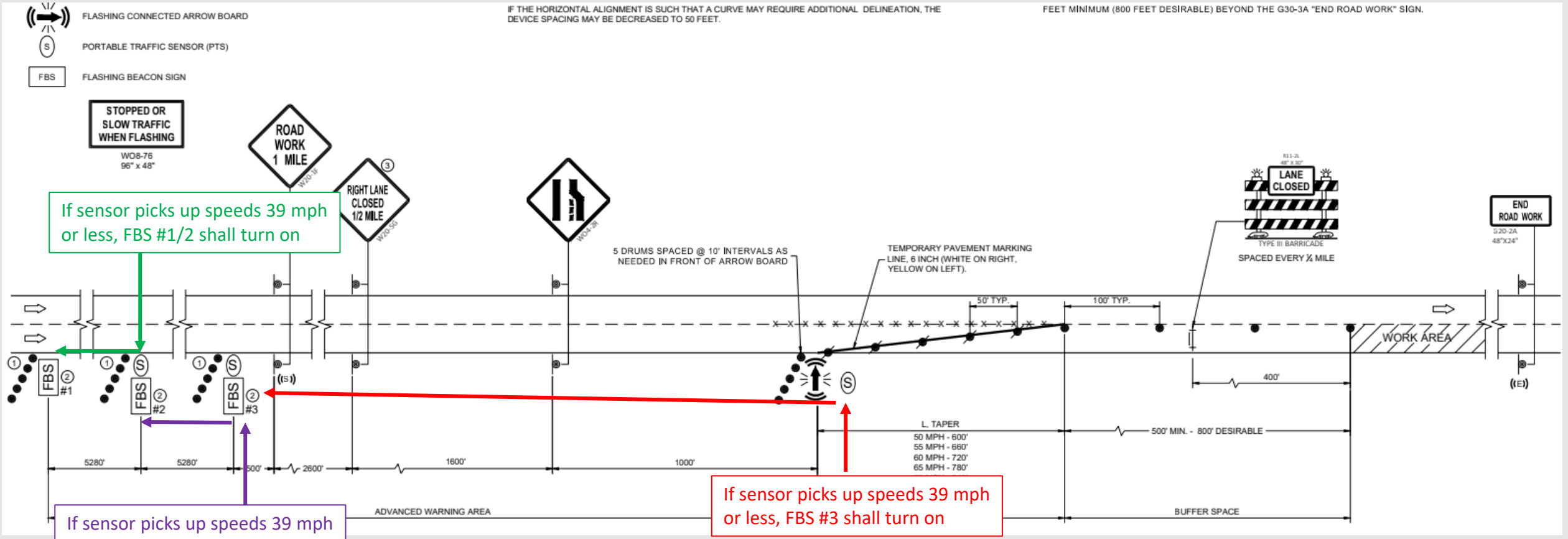
- If there are more than 2 lanes or higher truck percentage (greater than 20%), make sure to include FBS on both sides of the roadway.

BQWS – SDD 15D12d

- SDD may be modified to create a construction detail for unique scenarios



System Activation – speeds at 39 mph or below



If sensor picks up speeds 39 mph or less, FBS #1/2 shall turn on

If sensor picks up speeds 39 mph or less, FBS #2/3 shall turn on

If sensor picks up speeds 39 mph or less, FBS #3 shall turn on

Questions

Project #1

- 3 lanes
- AADT 59,000
- Daily/Nightly Closures – no queuing expected

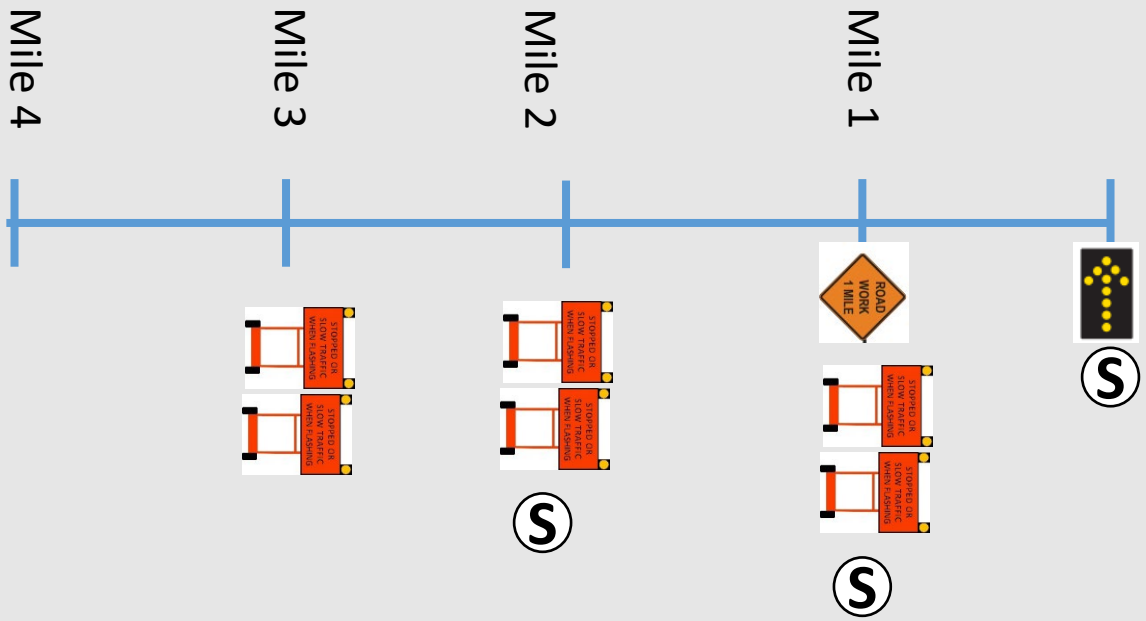
- Is a BQWS warranted?
  - How many FBS needed?
  - How many PTS needed?

Questions - Answers

Project #1 - Answer

- 3 lanes
- AADT 59,000
- Daily/Nightly Closures – no queuing expected

- Is a BQWS warranted? **YES**
  - How many FBS needed? **6 FBS**
  - How many PTS needed? **3 FBS**



Questions

Project #2

- 2 lanes
- AADT 28,600
- Daily/Nightly Closures – no queuing expected

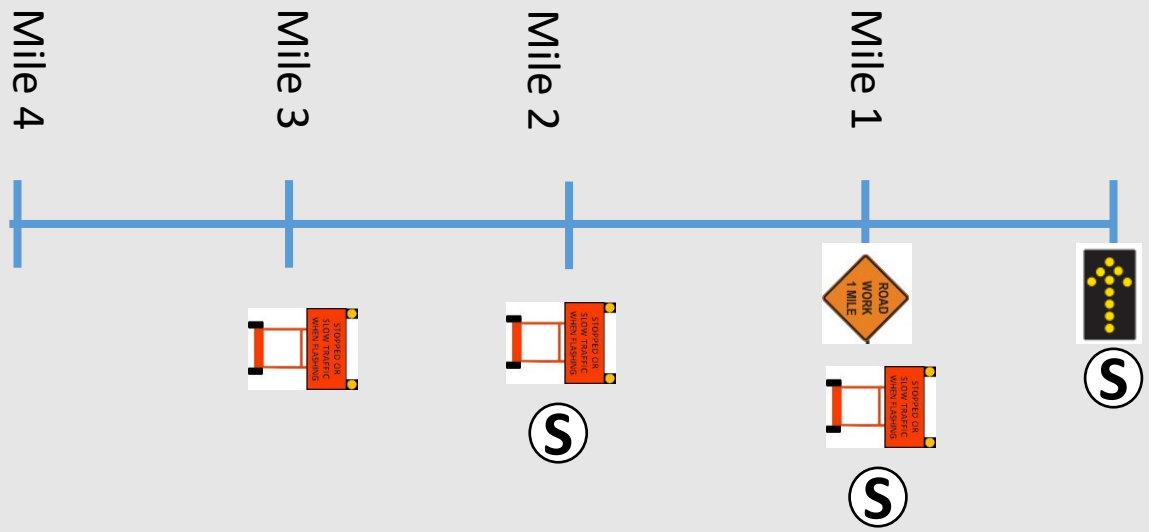
- Is a BQWS warranted?
  - How many FBS needed?
  - How many PTS needed?

Questions - Answers

Project #2

- 2 lanes
- AADT 28,600
- Daily/Nightly Closures – no queuing expected

- Is a BQWS warranted? **YES**
  - How many FBS needed? **3 FBS**
  - How many PTS needed? **3 PTS**



Questions

Project #3

- What is wrong with the MQ's tables?

BASIC QUEUE TRAFFIC WARNING SYSTEM

Location	Stage	643.1205.S BASIC QUEUE TRAFFIC WARNING SYSTEM DAY
PROJECT 1166-01-84		
CATEGORY 0010		
USH 51 SB	1	28
USH 51 NB	2	28
USH 51 NB	5	6
PROJECT 1166-01-84 TOTALS		62

BOARDS, AND SIGNS CONTINUED

ROADWAY	643.0900 TRAFFIC CONTROL SIGNS DAY	643.1050 TRAFFIC CONTROL PCMS DAY	643.1205.S BASIC TRAFFIC QUEUE WARNING SYSTEM DAY	643.1500 TRAFFIC CONTROL SPEED RADAR TRAILER DAY
IH 39 PRE WARNING				
WB	--	7		
EB	--	7		
IH 39 WB - STAGE 1A				
DOUBLE LANE CLOSURE	62	2	2	12
SINGLE LANE CLOSURE	27	1	15	6
SHOULDER CLOSURE	16	--	--	--
IH 39 WB - STAGE 1B				
DOUBLE LANE CLOSURE	93	3	3	18
SINGLE LANE CLOSURE	27	1	15	6
SHOULDER CLOSURE	16	--	--	--

Questions – Answers

Project #5

- What is wrong with the MQ's tables?

Table 25.3 BQWS Miscellaneous Quantities Reference

BASIC TRAFFIC QUEUE WARNING SYSTEM (QWS ITEM 643.1205.S)				
Location	Stage	FLASHING BEACON SIGNS (FBS)	PORTABLE TRAFFIC SENSORS (PTS)	BASIC QUEUE WARNING SYSTEM (DAY)
IH 41 NB	3	6	3	150
IH 41 SB	3	6	3	150

* These items are part of the QWS and are paid for one complete system per roadway

Ex: IH 41 has 3 lanes in each direction, therefore requiring FBS on both sides of the roadway.

CORRECT MQ'S

BOARDS, AND SIGNS CONTINUED

SHOULD HAVE OWN TABLE TO BREAK OUT DEVICES

ROADWAY	SIGNS DAY	643.1050 TRAFFIC CONTROL PCMS DAY	643.1205.S BASIC TRAFFIC QUEUE WARNING SYSTEM DAY	643.1500 TRAFFIC CONTROL SPEED RADAR TRAILER DAY
IH 39 PRE WARNING				
WB	--	7		
EB	--	7		

BASIC QUEUE TRAFFIC WARNING SYSTEM

Location	Stage	643.1205.S BASIC QUEUE TRAFFIC WARNING SYSTEM DAY			
PROJECT 1166-01-84			2	2	12
CATEGORY 0010			1	15	6
USH 51 SB	1	28	--	--	--
USH 51 NB	2	28			
USH 51 NB	5	6	3	3	18
PROJECT 1166-01-84 TOTALS		62	1	15	6
			--	--	--

MISSING FBS AND PTS QUANTITY

Activity #1 – 15 minutes

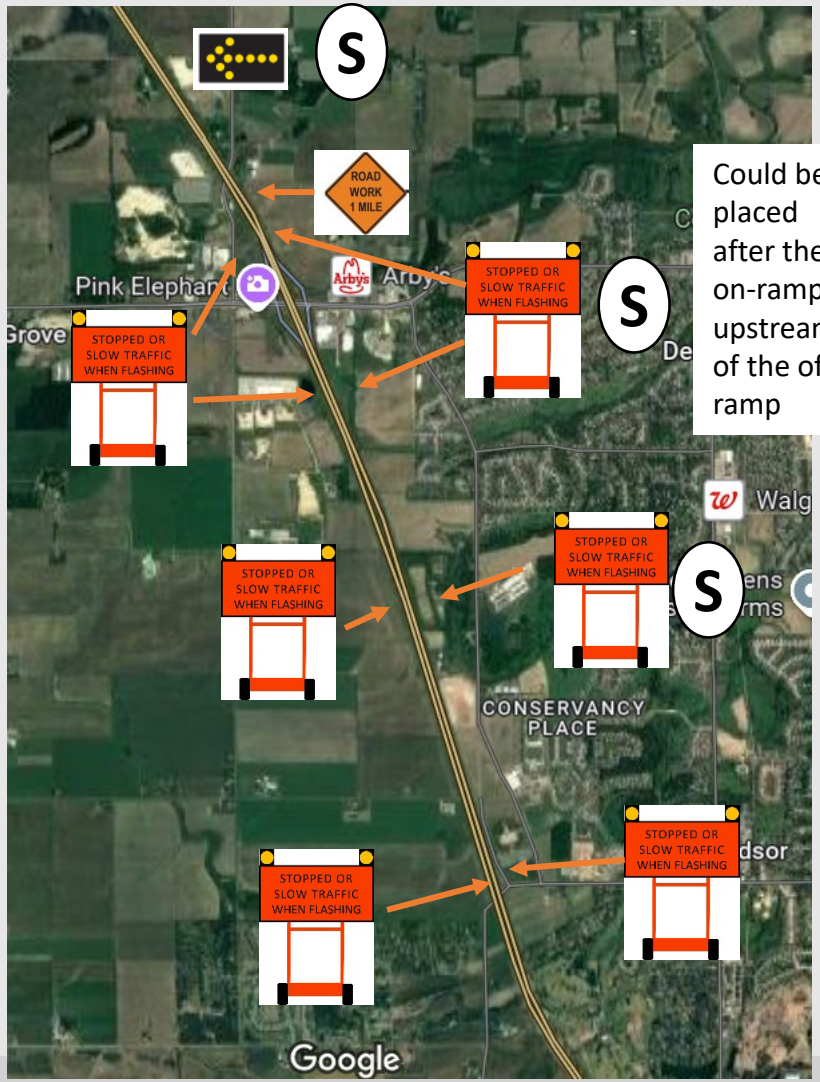
- Interstate 39/90/94, Columbia County
- AADT 57,600; 30% Trucks
- 3 Lanes
- Resurfacing Project
  - Off Peak/Nightly Lane Closures
  - No queuing expected
  - Stage 1: I 39/90/94 WB, 39 days

1. Layout Smart Work Zone Devices
   - FBS, PTS
2. Fill in Misc. Quantities Table

1 tick = ¼ mile

Activity #1 – Solution

- 6 FBS
  - FBS should be located on both sides of the roadway since it is a 3-lane facility with a higher truck percentage
    - 2 FBS 1 mile upstream of lane closure taper (consider placement based on interchange)
    - 2 FBS 2 miles upstream of lane closure taper
    - 2 FBS 3 miles upstream of lane closure taper
- 3 Sensors
  - Sensors are required in the following locations:
    - arrow board or near the lane closure taper
    - 1 mile upstream of lane closure taper
    - 2 miles upstream of lane closure taper
- Misc. Quantities Table



Could be placed after the on-ramp or upstream of the off-ramp

Basic Traffic Queue Warning System

Location	Stage	Flashing Beacon Signs (FBS)	Portable Traffic Sensors (PTS)	Basic Queue Warning System (DAY)
I 39/90/94 WB	1	6	3	39

Portable Real-Time Traffic Queue Warning Systems (QWS)

- When to use a QWS?
  - When queuing is expected
  - When there are alternate routes nearby
  - To provide traveler information with travel times or distance to back of queue

QWS Design

- PTS – placed in the advance warning area at the taper and then every 1 mile to capture vehicle speeds
- PCMS – placed every 1 mile upstream of lane closure taper to one mile upstream of estimated maximum queue length
- Ex. Max queue per WZTAT = 6 Miles
  - 2 Lanes - 7 PCMS, 7 PTS
  - 3 Lanes – 14 PCMS, 7 PTS
- Ex. Max Queue per WZTAT = 4 miles
  - 2 Lanes - 5 PCMS, 5 PTS
  - 3 Lanes – 10 PCMS, 5 PTS

QWS - MQ's Table

- Make sure to break out the table and include all components so the contractor knows the number of devices
  - This is for a project with a 4 mile queue expected in the EB direction and a 3 mile queue expected in the WB direction

PORTABLE AUTOMATED REAL-TIME TRAFFIC QUEUE WARNING SYSTEM
(QWS ITEM 643.1200.S)

Location	Stage	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	PORTABLE TRAFFIC SENSORS (PTS)	QUEUE WARNING SYSTEM (DAY)
IH 94 EB	1	5	5	100
IH 94 EB	2	5	5	70
IH 94 WB	1	4	4	100
IH 94 WB	2	4	4	70

* These items are part of the QWS and are paid for one complete system per roadway

PCMS Messages and Speed Thresholds

- Speeds - Engineer can make modifications to speed if needed

Free Flow:

If the current speed on a roadway section is at or above 40 mph, the upstream PCMS shall display nothing except for lighting the four corners (flashing caution mode) to show that it is on.

Slow Traffic:

If the current speed on any downstream section of the roadway is between the 39 mph and 20 mph (for example, 35 mph), the following two phase messages will be displayed on the upstream PCMS as shown below:

EVENT	FRAME 1	FRAME 2
Speeds 20 mph to 39 mph	SLOW TRAFFIC AHEAD	PREPARE TO STOP

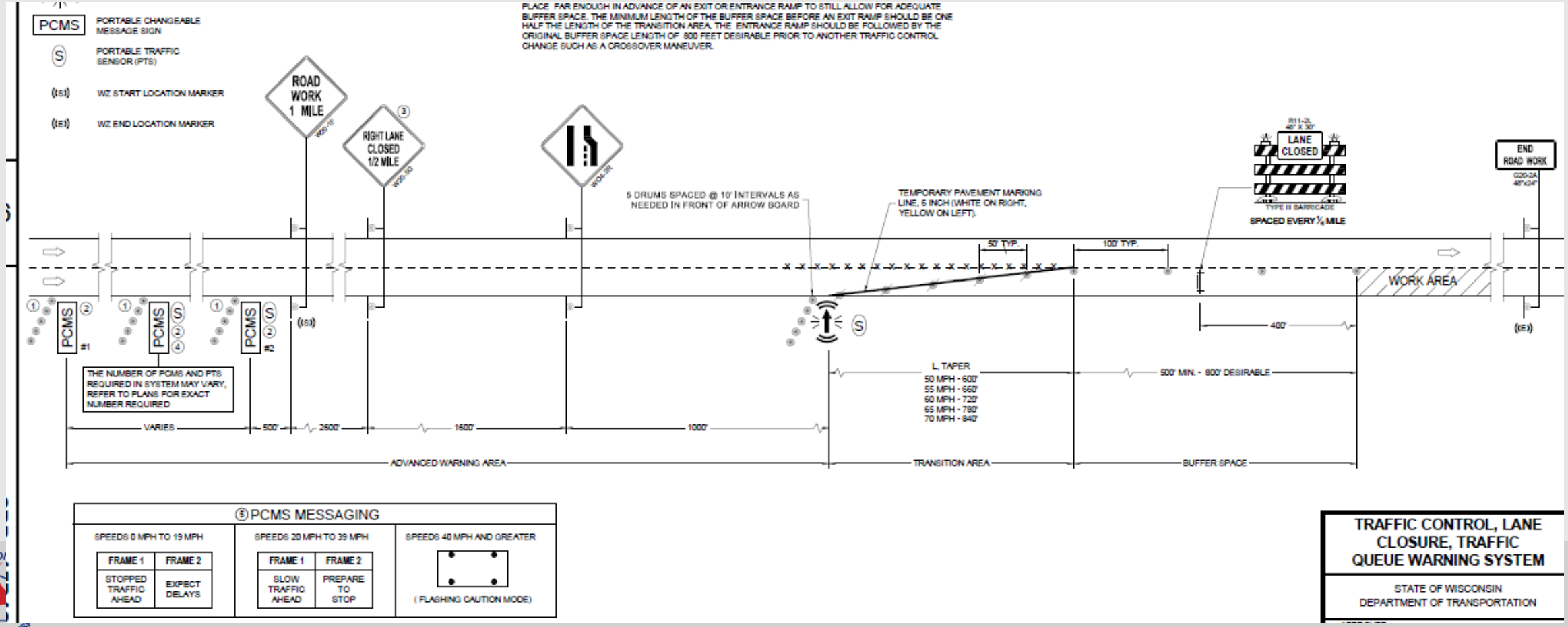
Stopped Traffic:

If the current speed on a roadway section of the roadway drops below 20 mph, the following two phase messages will be displayed on the upstream PCMS as shown below:

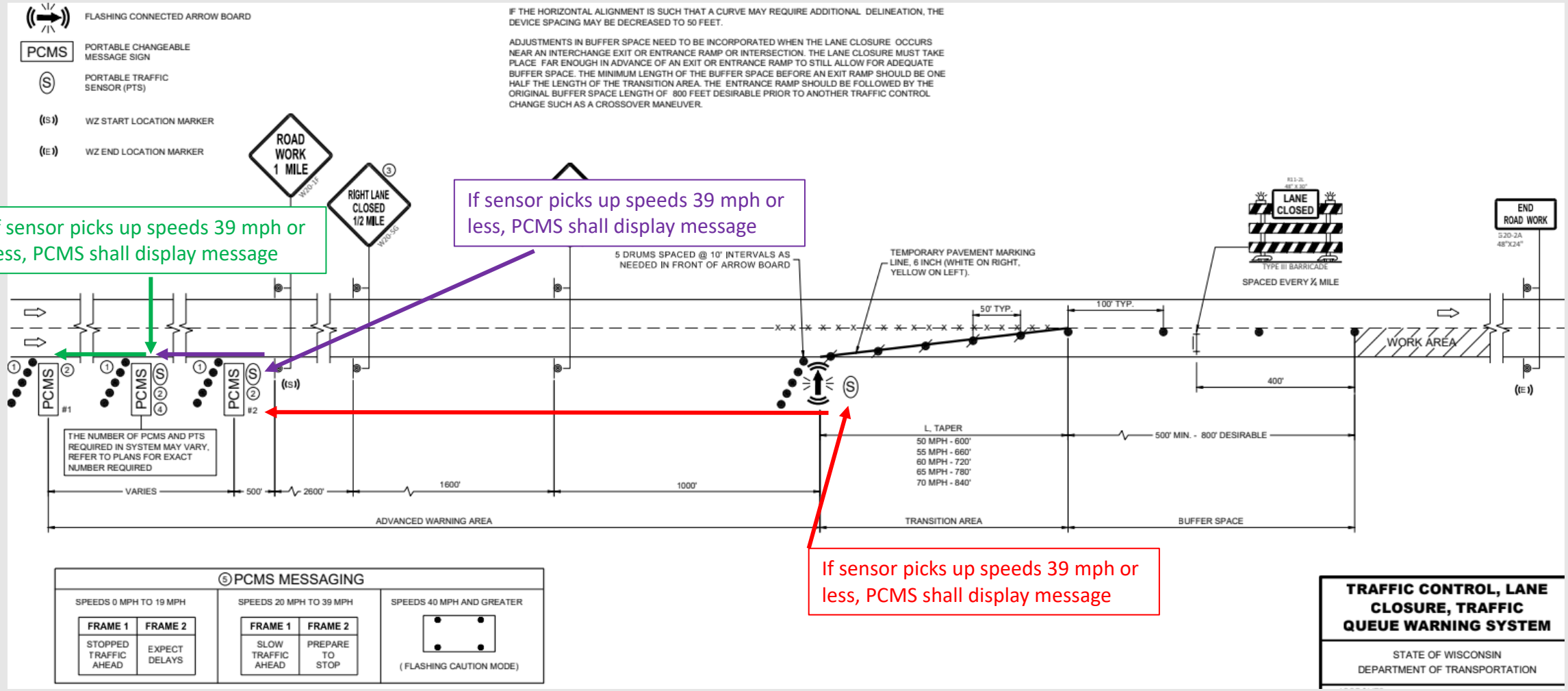
EVENT	FRAME 1	FRAME 2
Speeds 0 mph to 19 mph	STOPPED TRAFFIC AHEAD	EXPECT DELAYS

QWS – SDD 15D12e

- SDD may be modified to create a construction detail for unique scenarios
  - Not a one size fits all for smart work zones



QWS – System Activation



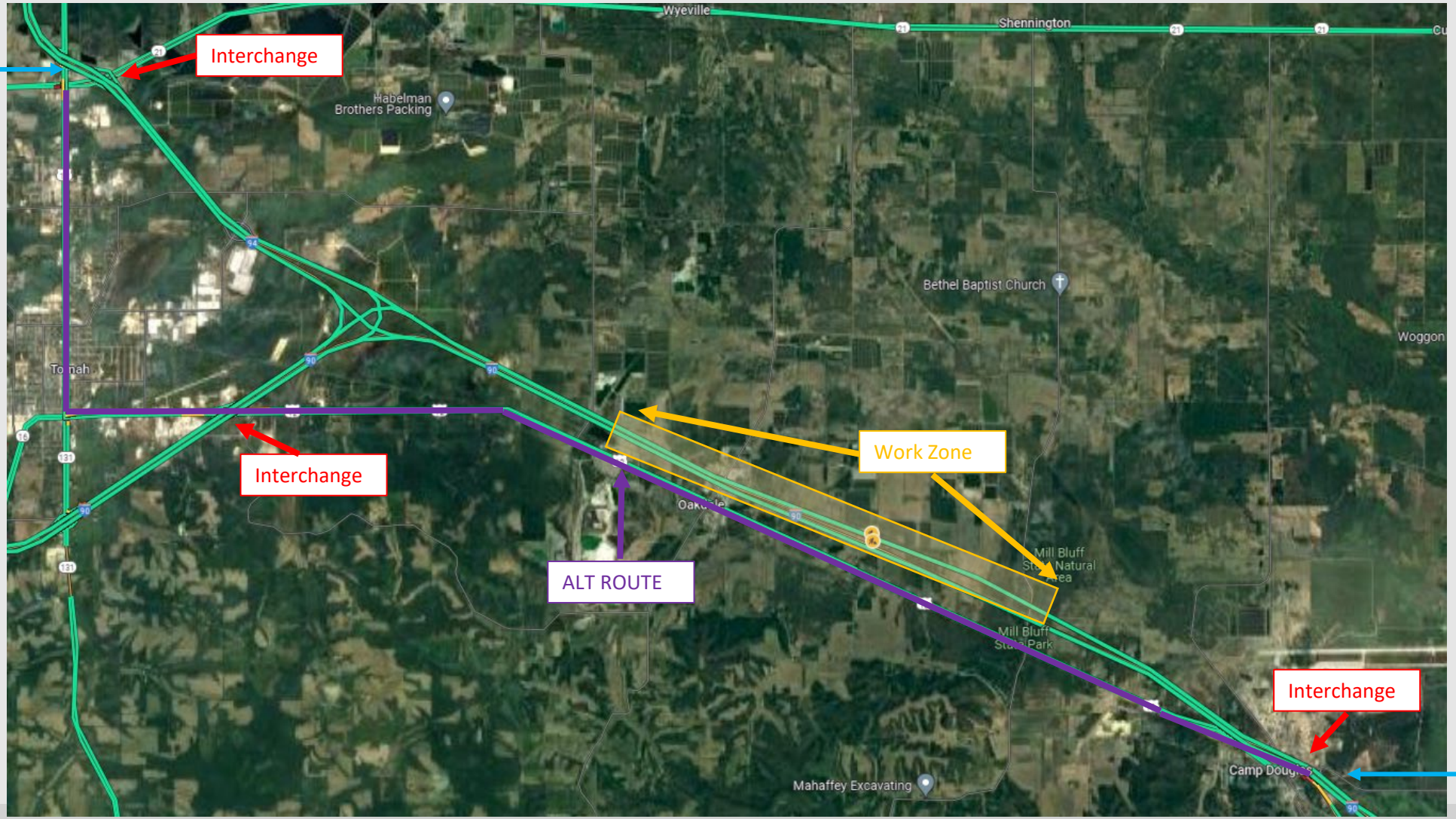
Additional QWS Options

- Travel Time System
  - If there are alternate routes near the project, a travel time system could be implemented with the QWS
  - Promote additional diversion, especially during regular queuing and incidents
  - Place PCMS upstream of off-ramp
  - SPV, need to coordinate with the Traffic Management Center

- Alternative Messages
  - Use alt route when queueing gets to a certain interchange

Travel Time System

PCMS
HWY C
XX MILES
XX MIN



PCMS
HWY 21
XX MILES
XX MIN

WISCONSIN DEPARTMENT OF TRANSPORTATION

Questions

Project #1

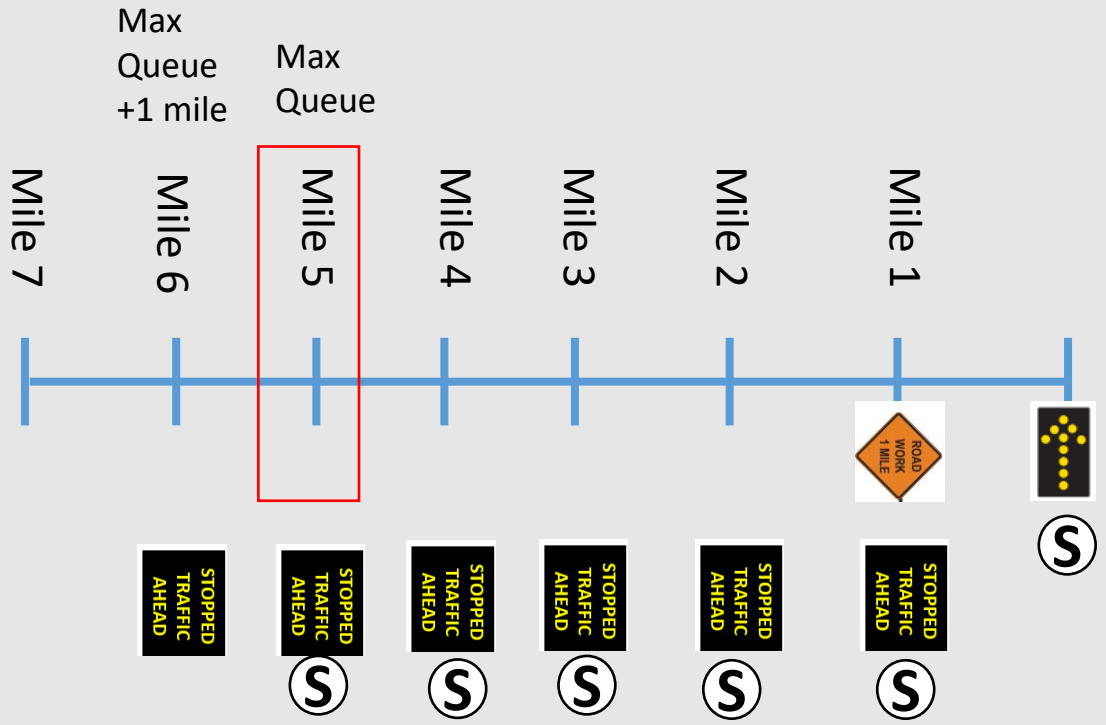
- 2 lanes
- AADT 36,200
- 15% Trucks
- Long-Term Lane Closure
- Expected Max Queue = 5 miles

- What Smart Work Zone should be used?
- How many PCMS needed?
- How many PTS needed?

Questions – Answers

Project #1

- What Smart Work Zone should be used?
  - **QWS**
- How many PCMS needed?
  - **6 PCMS**
- How many PTS needed?
  - **6 PTS**
  - **1 in lane closure taper, 5 PTS upstream**



Questions

Project #2

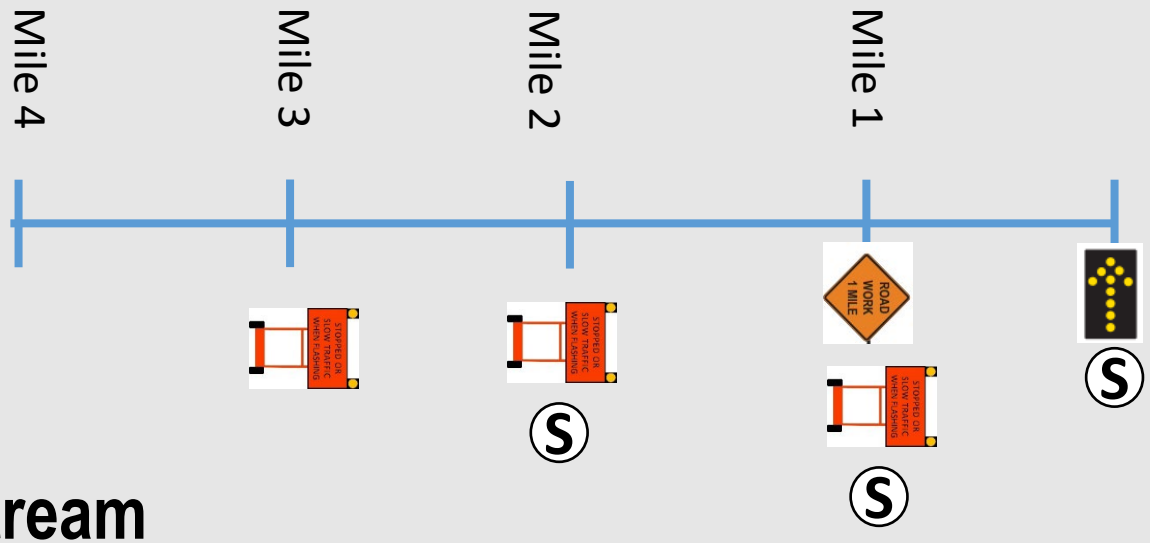
- 2 lanes
- AADT 27,700
- 12% Trucks
- Long-Term Single Lane Closure
- No queueing expected

- What Smart Work Zone should be used?
- How many PCMS needed?
- How many PTS needed?

Questions – Answers

Project #2

- What Smart Work Zone should be used?
  - **BQWS**
- How many PCMS needed?
  - **3 FBS**
- How many PTS needed?
  - **3 PTS**
  - **1 in lane closure taper, 2 upstream**



Questions

Project #3

- What is wrong with the MQ's table?

PORTABLE AUTOMATED REAL-TIME TRAFFIC QUEUE WARNING SYSTEM (QWS ITEM 643.1200.S)

Location	Stage	QUEUE WARNING SYSTEM (DAY)
I 39/90/94 WB	1	55
I 39/90/94 WB	2	74
I 39/90/94 EB	1	55
I 39/90/94 EB	2	74

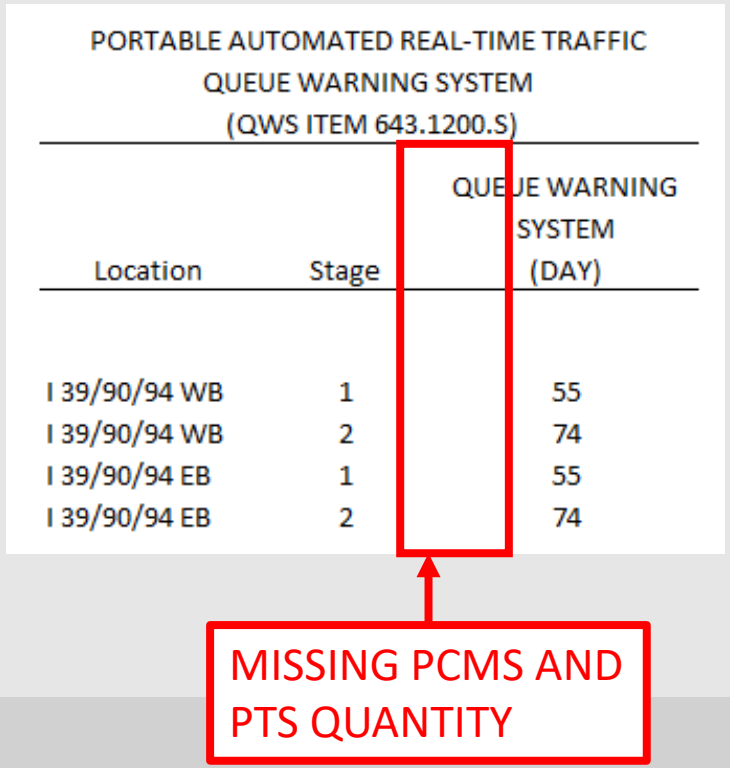
Examples - Answers

Project #3

- What is wrong with the MQ's table? **Missing PCMS and PTS quantities**

PORTABLE AUTOMATED REAL-TIME TRAFFIC QUEUE WARNING SYSTEM
(QWS ITEM 643.1200.S)

Location	Stage	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	PORTABLE TRAFFIC SENSORS (PTS)	QUEUE WARNING SYSTEM (DAY)
I 39/90/94 WB	1	6	6	55
I 39/90/94 WB	2	6	6	74
I 39/90/94 EB	1	6	6	55
I 39/90/94 EB	2	6	6	74

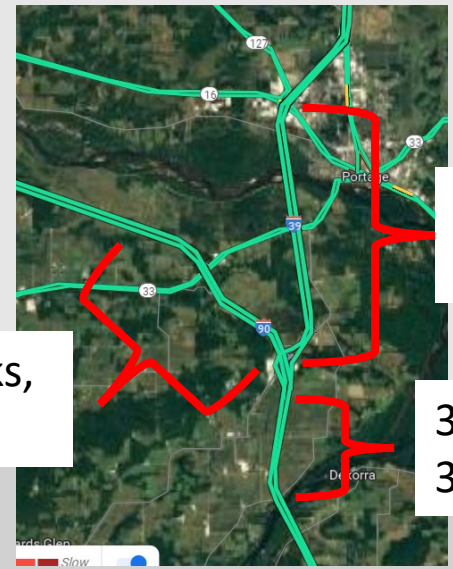


Activity #2 – 15 minutes w/ Break

- Bridge Reconstruction
  - I 39/90/94 = 57,600, 30% Trucks
  - I-39, 2 lanes each direction, 15% Trucks
  - I-90/94, 2 lanes each direction, 15% trucks
  - Possible queueing up to 4 miles
  - Stage 1: I 39/90/94 EB, 265 days
  - Queuing anticipated north of interchange on both I 90/94 and I 39.
  - Possible Alternative Routes
  - Speeds are identified on layouts

1. Layout Smart Work Zone Devices
   - PCMS, PTS
2. Fill in Misc. Quantities Table

1 tick = ¼ mile

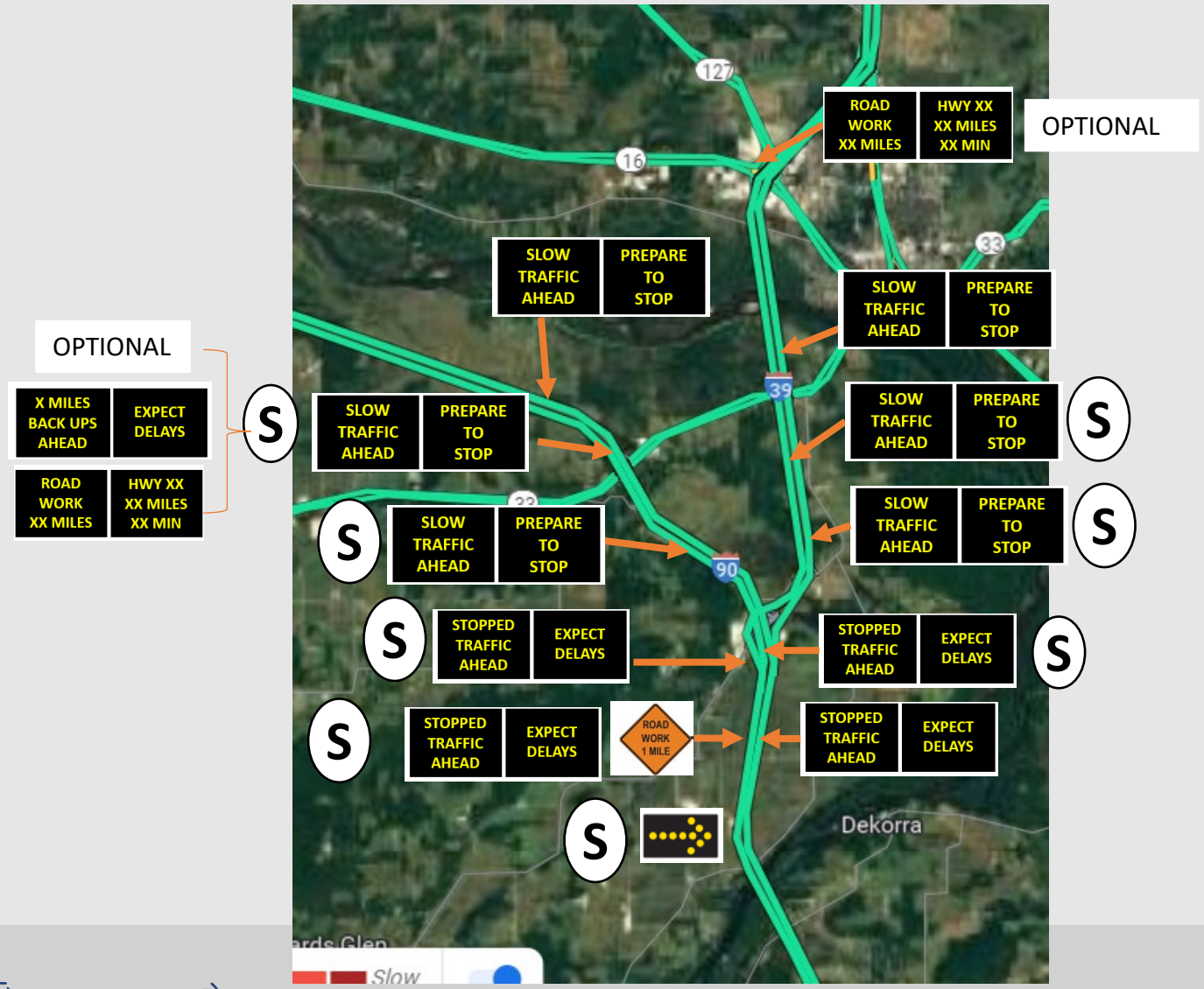


Activity #2 – Solution

- Devices
  - 6 Slow Traffic PCMS
  - 4 Stopped Traffic PCMS
  - 8 PTS
  - Optional PCMS for TT at HWY 33 and HWY 16 Interchanges

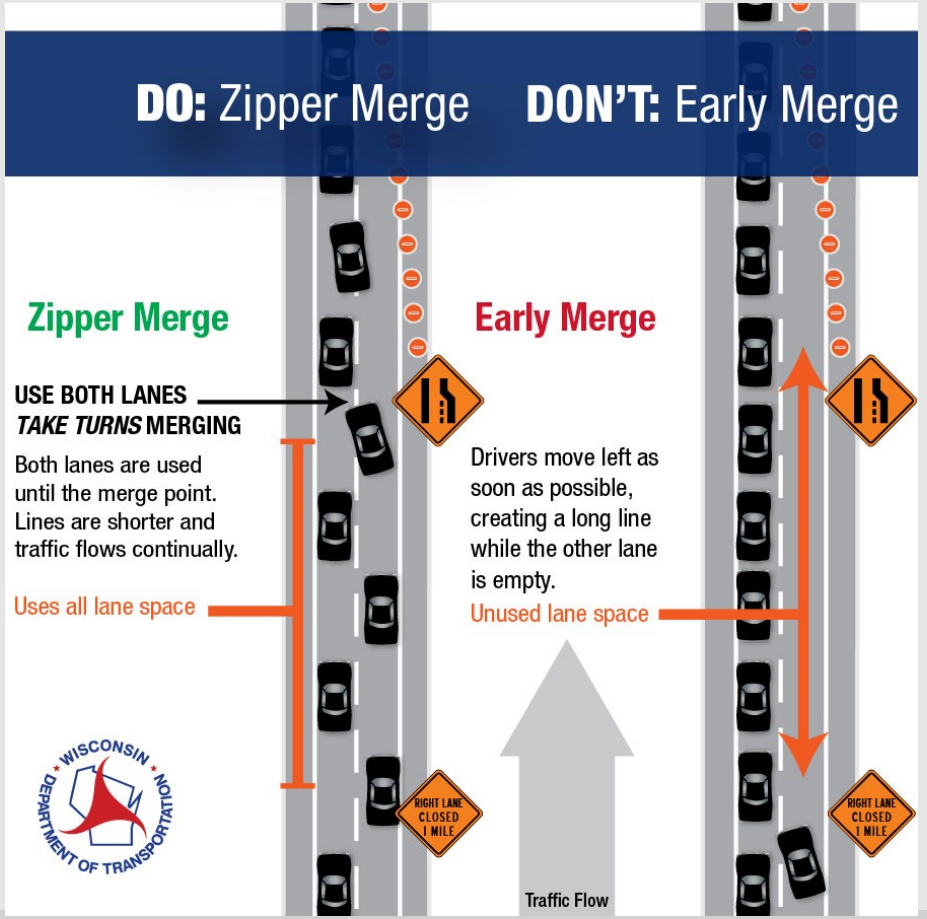
- Misc. Quantities Table

PORTABLE AUTOMATED REAL-TIME TRAFFIC QUEUE WARNING SYSTEM				
LCOATION	STAGE	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	PORTABLE TRAFFIC SENSORS (PTS)	QUEUE WARNING SYSTEM (DAY)
I 39/90/94 EB	1	10	8	265



Dynamic Late Merge System (DLMS) or Zipper Merge

- What is the Zipper Merge?
  - Allows drivers to use all lanes of traffic until the merge area is reached. At this point, motorists should merge in an alternating fashion, like a zipper.
  - During free-flow conditions, drivers use the early merge method
  - During congested conditions, drivers use the “late” merge method



When to use a DLMS?

- Used when regular recurring congestion will occur as part of a lane closure in a work zone
- Single Lane Closure
- Urban or Rural Areas
- Commuter Route

DLMS Design

- PCMS – two located in the advance warning area to display messages on the late merge and one-1 mile upstream of max queue to tell motorists to use all lanes
  - all PCMS turn on at the same time
  - Use 2 PCMS at the same location on both sides of the roadway for the furthest upstream location if 3 lanes or higher truck percentage
- PTS – two placed in the advance warning area and then every 1 mile on FBS to capture vehicle speeds
  - furthest upstream FBS does not need a PTS

DLMS Design

- FBS – placed every 1 mile upstream of lane closure taper to the estimated maximum queue length
  - Ex: Max Queue = 4 miles, 2 lanes in each direction
    - 3 PCMS
    - 5 PTS
    - 4 FBS
  - Ex: Max Queue = 6 miles, 3 lanes in each direction
    - 4 PCMS
    - 7 PTS
    - 12 FBS

PCMS Messages

- Speeds - Engineer can make modifications to speed if needed
  - System turns on at 39 mph or below

Point of merge (PCMS #3):

FRAME 1	FRAME 2
MERGE HERE	TAKE TURNS

Intermediate PCMS (PCMS #2):

FRAME 1	FRAME 2
STAY IN LANE	DO NOT MERGE

PCMS located beyond estimated maximum queue length for two-lane configuration (PCMS #1):

FRAME 1	FRAME 2
STOPPED TRAFFIC AHEAD	USE BOTH LANES

PCMS located beyond estimated maximum queue length for three-lane configuration (PCMS #1

FRAME 1	FRAME 2
STOPPED TRAFFIC AHEAD	USE ALL LANES

DLMS – MQ's Table

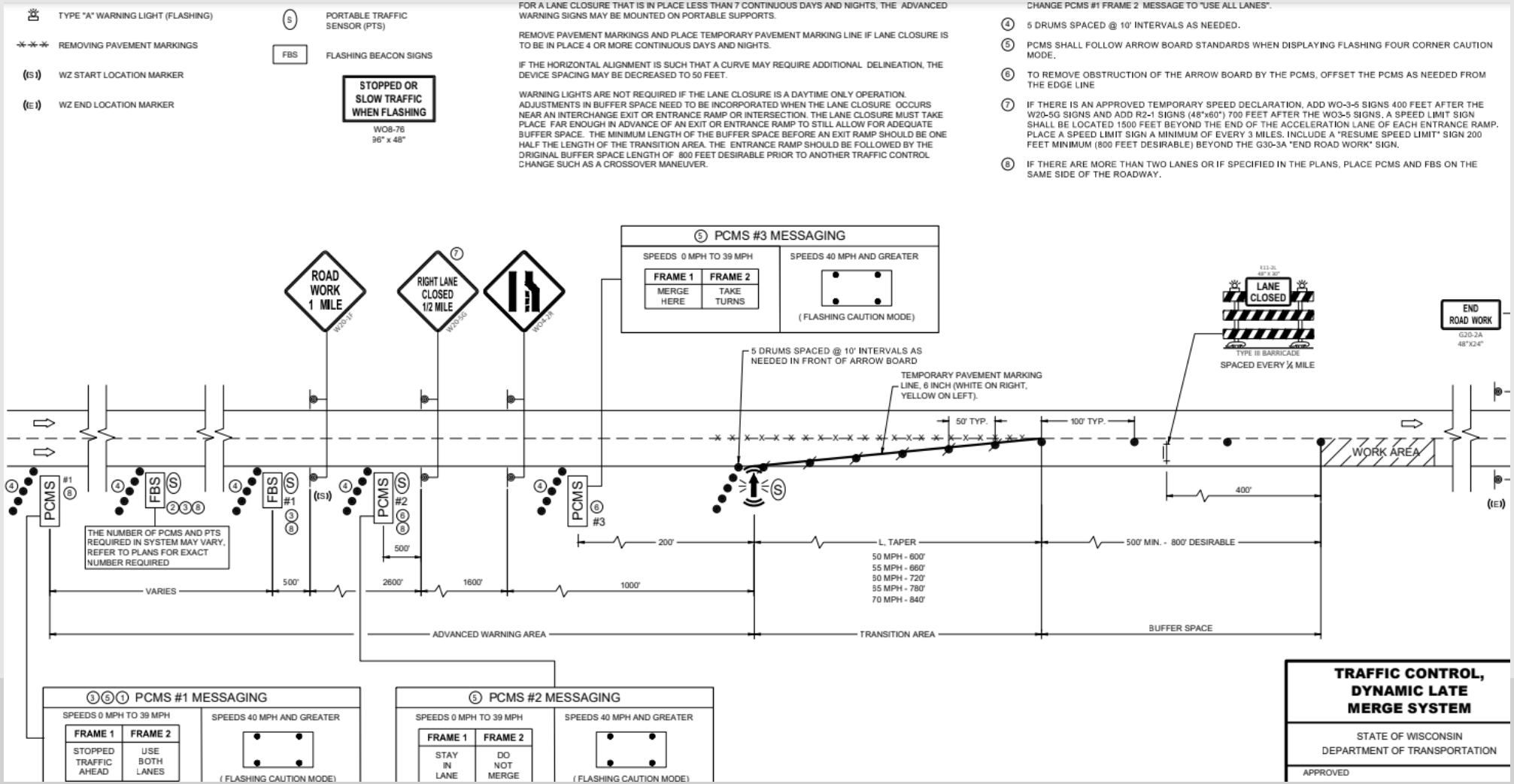
- Miscellaneous Quantities
  - Include FBS, PCMS and PTS
  - Ex: 2 Mile Queue Expected
    - 3 PCMS, 2 FBS, 3 PTS

DYNAMIC LATE MERGE SYSTEM (DLMS ITEM 643.1100.S)

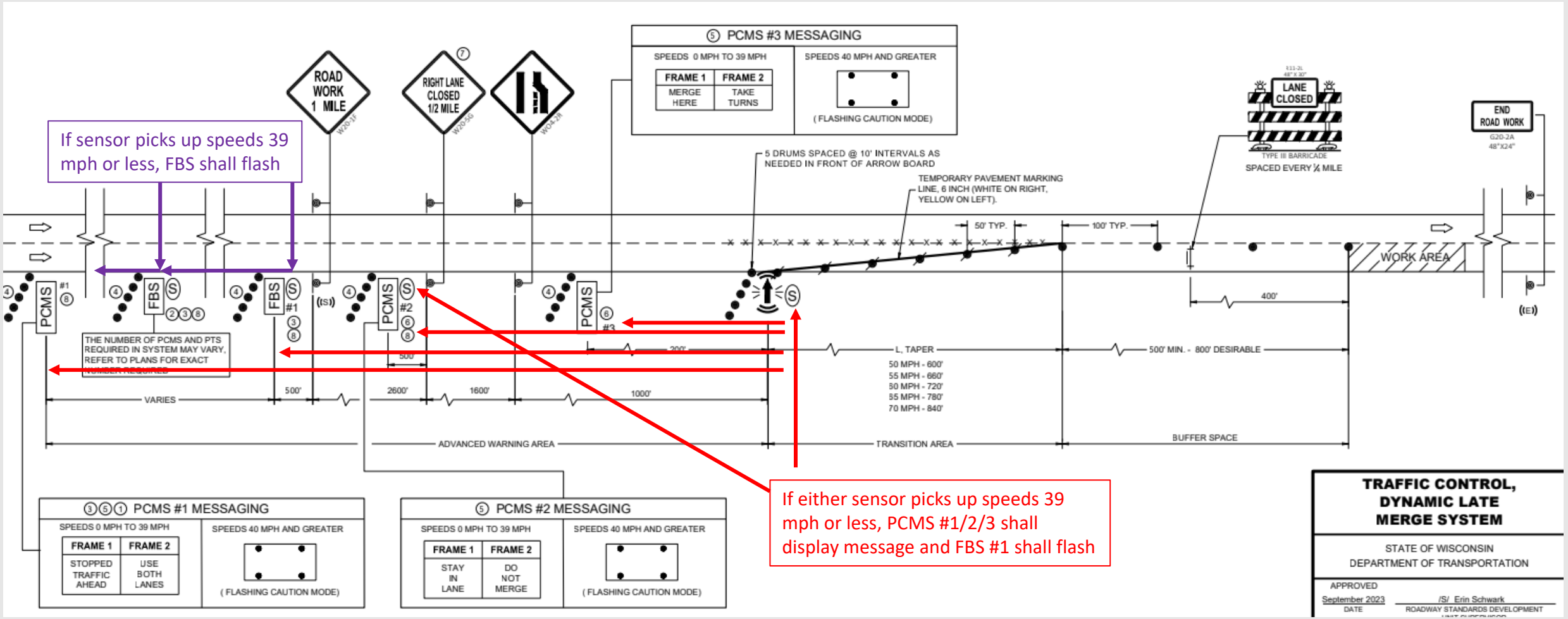
LOCATION	STAGE	FLASHING BEACON SIGNS (FBS)	PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)	PORTABLE TRAFFIC SENSORS (PTS)	DYNAMIC LATE MERGE SYSTEM (DAY)
I 94 EB	1	2	3	3	95
I 94 WB	1	2	3	3	95

DLMS – SDD 15D12c

- SDD may be modified to create a construction detail for unique scenarios



DLMS – System Activation



Questions

Project #1

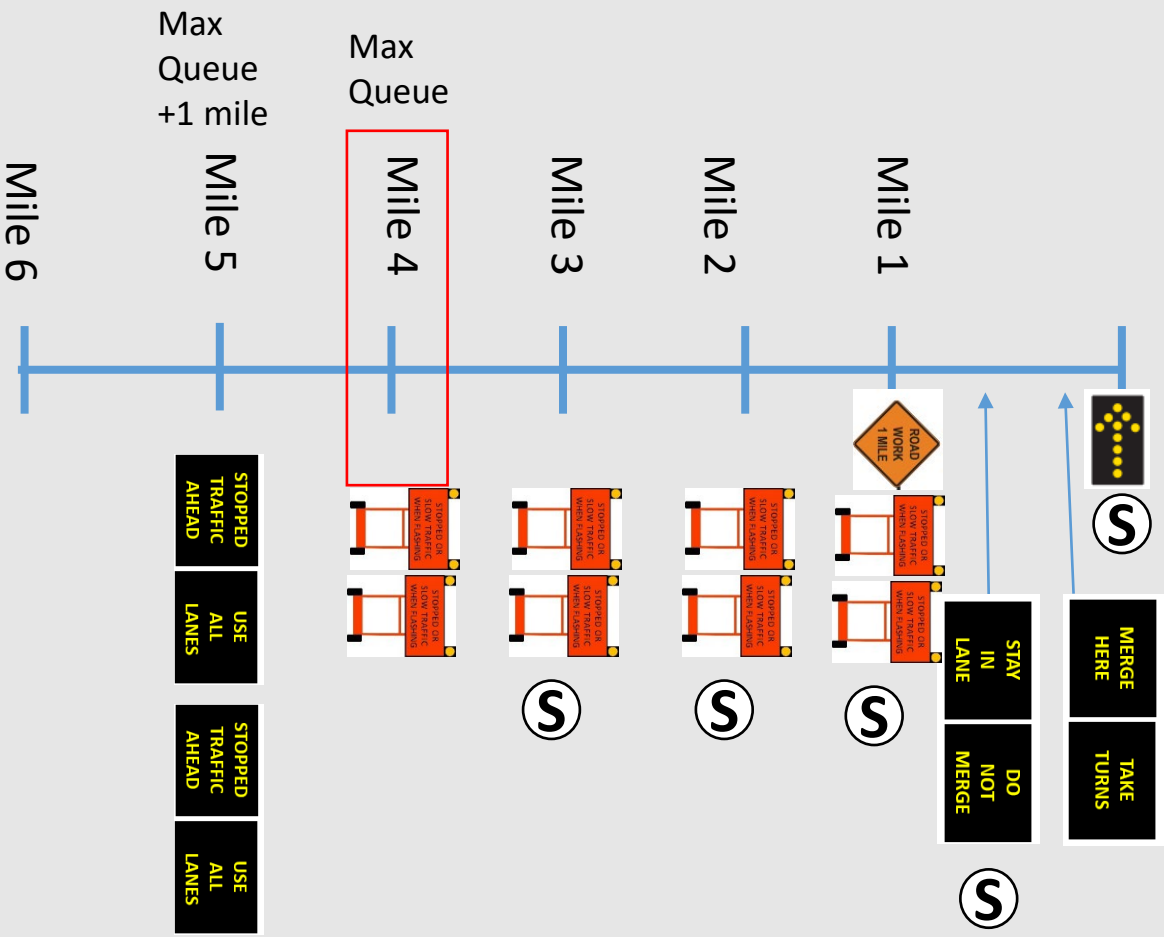
- 3 lanes
- AADT 160,000
- 30% Trucks
- Long-Term Lane Closure
- Commuter Route
- Expected Max Queue = 4 miles

- What Smart Work Zone should be used?
- How many PCMS & FBS needed?
- How many PTS needed?

Examples – Answers

Project #1

- What Smart Work Zone should be used?
  - **DLMS**
- How many PCMS & FBS needed?
  - **4 PCMS**
  - **8 FBS**
- How many PTS needed?
  - **5 PTS**
  - **2 advanced warning area, 3 upstream**



Questions

Project #2

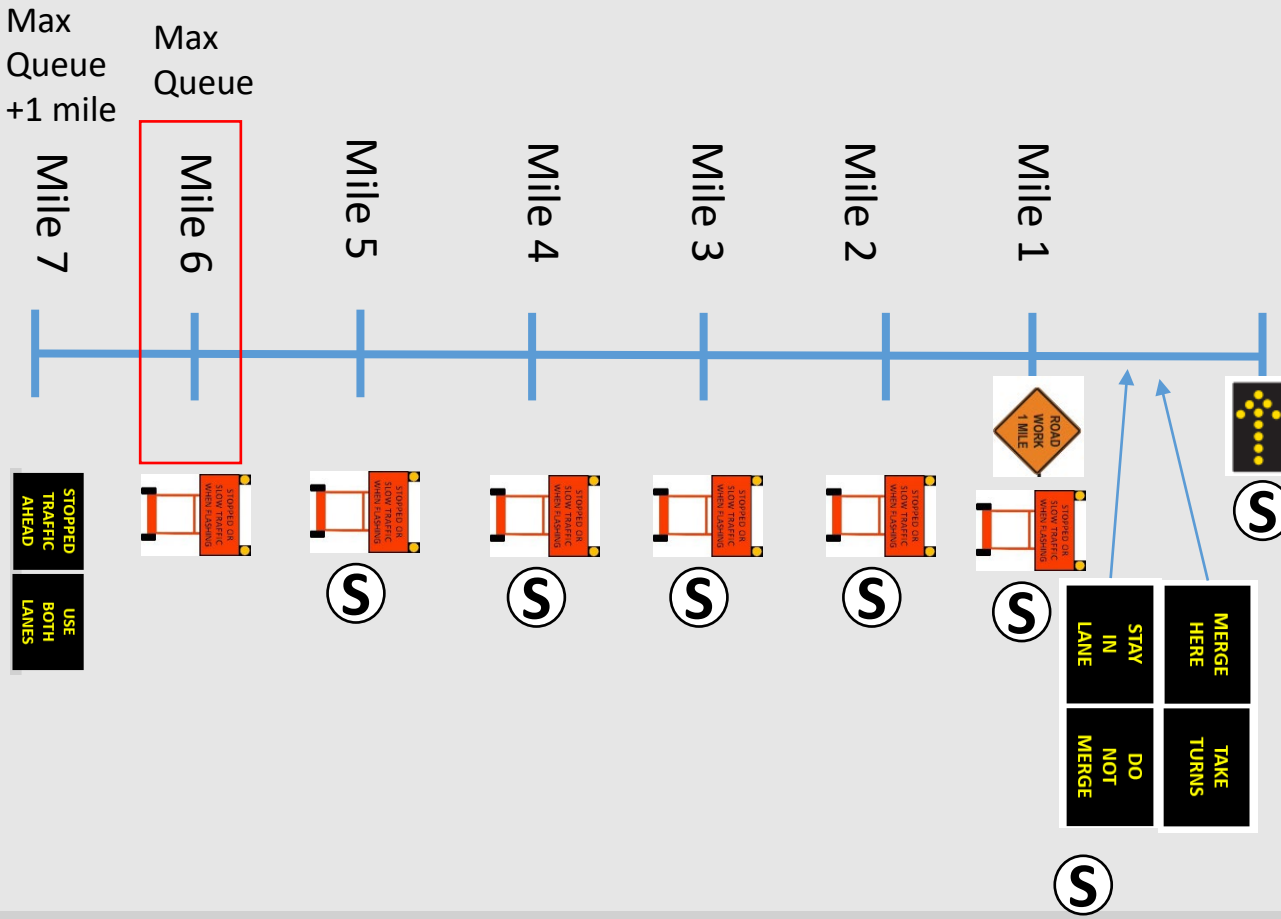
- 2 lanes
- AADT 40,000
- 15% Trucks
- Long-Term Single Lane Closure
- Rural, Recreational Route
- Expected Max Queue = 6 miles

- What Smart Work Zone should be used?
- How many PCMS & FBS needed?
- How many PTS needed?

Examples – Answers

Project #2

- What Smart Work Zone should be used?
  - **DLMS or QWS**
- How many PCMS & FBS needed?
  - **3 PCMS**
  - **6 FBS**
- How many PTS needed?
  - **7 PTS**
  - **2 in advance warning area, 5 upstream**



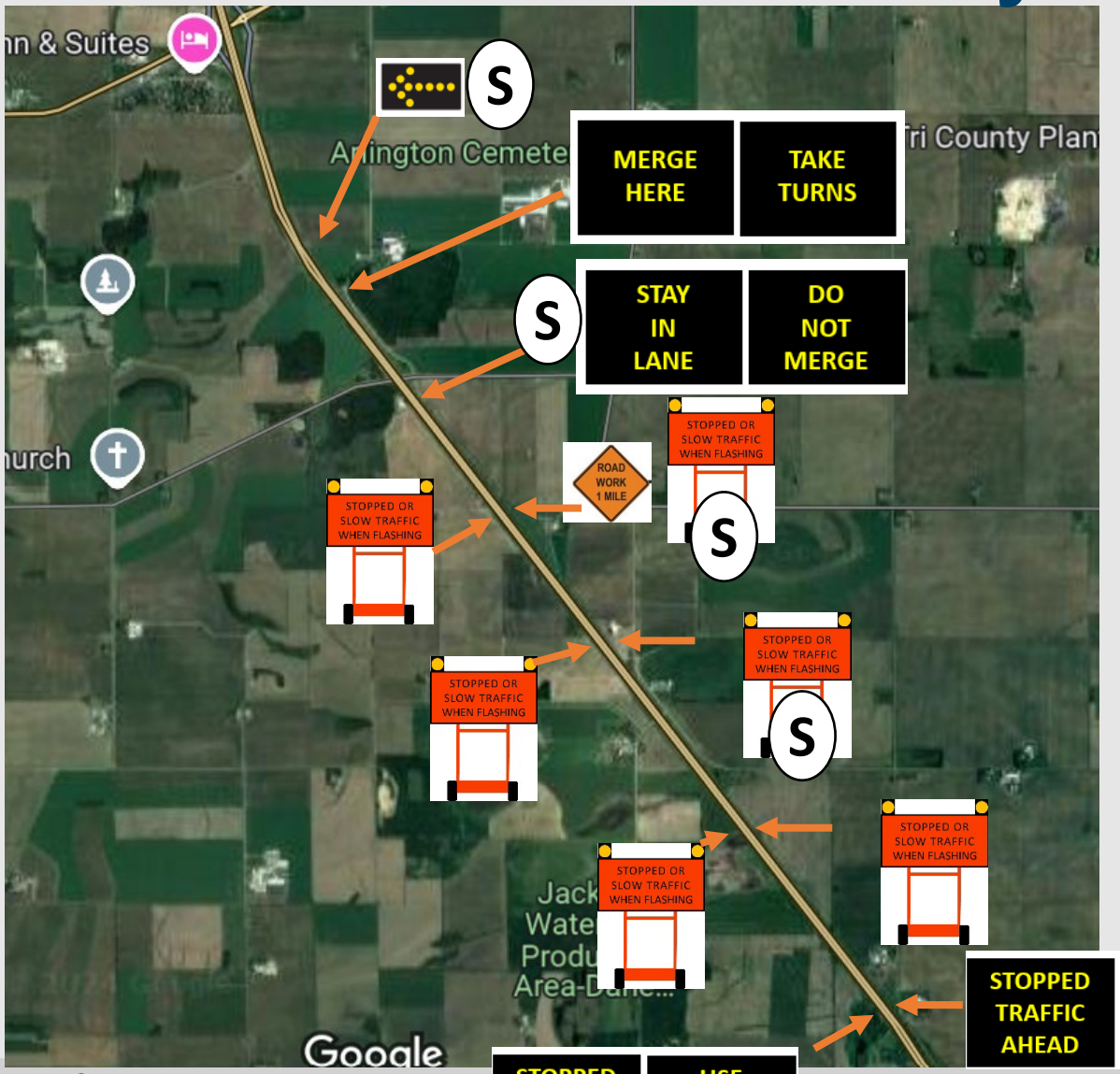
Activity #3 – 15 minutes

- Interstate 90/94
- AADT 30,600; 30% Trucks
- 3 Lanes
- Resurfacing
  - Long-term single lane closure
  - Commuter Route
  - Max Queue – 3 miles
  - Stage 1, I 90/94, 90 days

1. Layout Smart Work Zone Devices
   - PCMS, FBS, PTS
   - Fill in Misc. Quantities Table

1 tick = ¼ mile

Activity #3 – Plan



- 4 PCMS
  - 1 - 200 feet upstream of lane closure taper
  - 1 - 2,100 feet upstream of lane closure taper
  - 2 - 4 miles upstream of lane closure taper on both sides of roadway
- 4 Sensors
  - arrow board or near the lane closure taper on I-39/90
  - PCMS – Stay in Lane/Do Not Merge
  - 1 mile upstream of lane closure taper on I-39/90
  - 2 miles upstream of lane closure taper on I-39/90
- 6 FBS
  - 2 -1 mile upstream of lane closure taper on I-39/90
  - 2 - 2 miles upstream of lane closure taper on I-39/90
  - 2 – 3 miles upstream of lane closure taper on I 39/90

DYNAMIC LATE MERGE SYSTEM

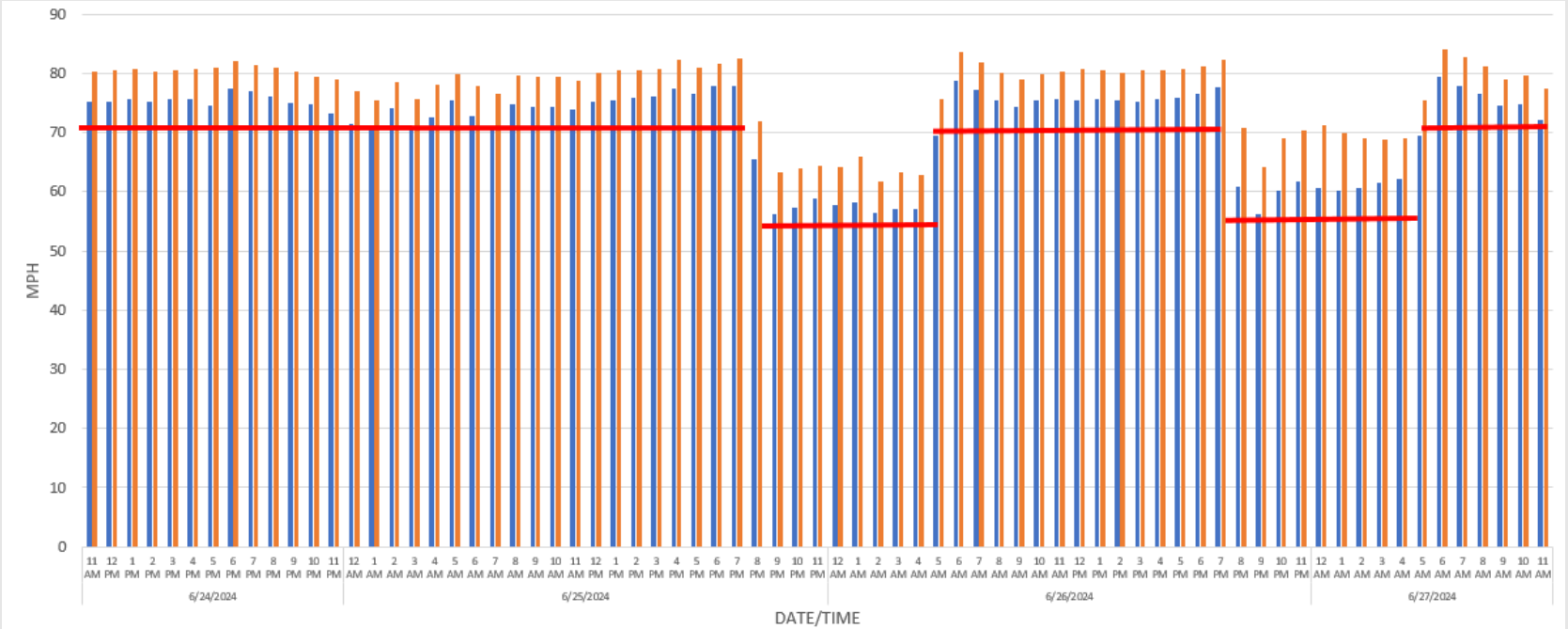
Location	Stage	Flashing Beacon Signs (FBS)	Portable Changeable Message Signs (PCMS)	Portable Traffic Sensors (PTS)	Dynamic Late Merge System (DAY)
I 90/94 WB	1	6	4	4	37

Digital Speed Reduction System (DSRS)

- Allows the speed limit to be lowered remotely to reduce the exposure of workers on the side of the road covering and uncovering the speed limit signs
- Provides more consistent work zone speed limit signing
- Allows for data to be downloaded and checked to ensure speed limits are changing correctly
- More visible to the motorists with flashing beacons during reduced speeds
- Potential for better compliance to the work zone speed limit

Pilot Projects

- Completed 8 pilot projects in 2024
- All regions
- Feedback from projects and contractors was very positive



When to use a DSRS?

- FDM Guidance will be published late Fall 2024
- Primarily used on resurfacing projects
- Used on projects with temporary speed limits
  - Daily/Nightly Lane Closures – temp speed limit only applies when workers are present
  - Weekly Lane Closures – temp speed limit only applies when workers are present
  - Long-Term Lane Closures – temp speed limit only applies when workers are present

DSRS STSP – coming in 2025

- Currently using an SPV
  - *Talk to your Work Zone Engineer for SPV until STSP is published in early 2025*
- Digital Speed Limit Trailer (DSLT)
  - Includes Digital Sign with Flashing Beacons
  - Devices on the WisDOT APL
- Automated System Manager (ASM)

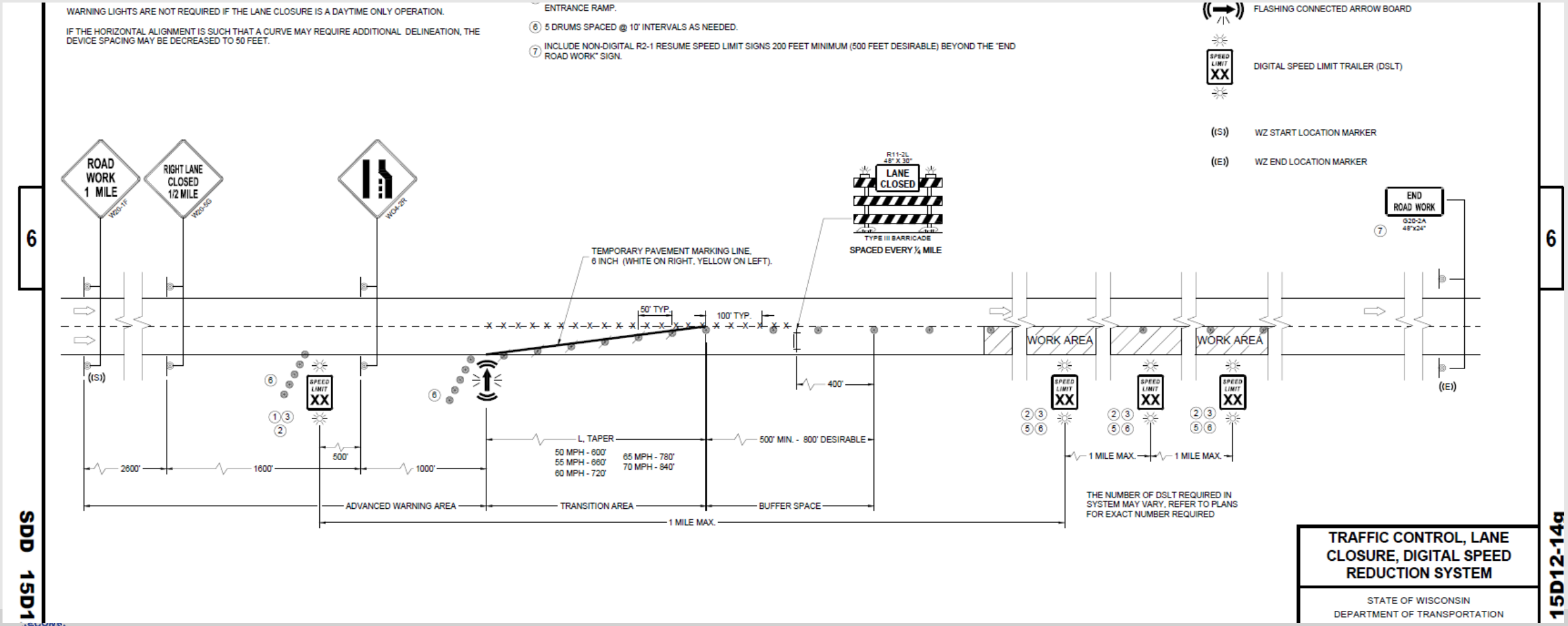
DSRS – MQ's

- Break out the number of DSLT needed for the project
- System is paid
  - Per day, per direction
- Break out each stage

DIGITAL SPEED REDUCTION SYSTEM (DSRS)

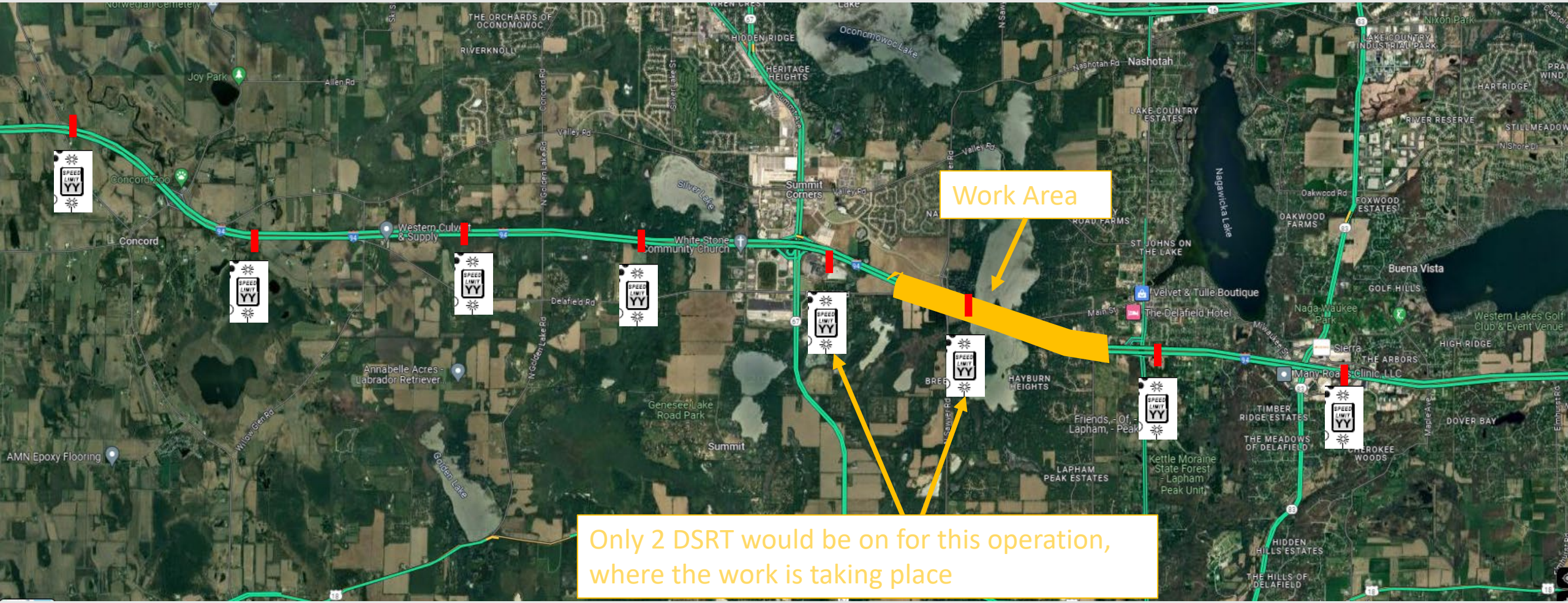
LOCATION	STAGE	DIGITAL SPEED LIMIT TRAILERS (DSLT)	DIGITAL SPEED REDUCTION SYSTEM (DAY)
IH 94 SB	1	7	35
IH 94 NB	1	7	35
IH 94 SB	2	5	71
IH 94 NB	2	5	71

DSRS SDD - coming Fall 2024



Recommendations for Construction

- Review placement of devices, tips below:
  - Ensure DSLT is placed after on-ramps
  - Ensure DSLT are placed a minimum of every 1 mile
- Confirm Speed Limit is changing when workers are present and beacons are flashing during reduced speed limit
- Ensure you get weekly reporting on changes in speed limits
- Ensure the contractor is only the changing the speed limit in the areas where active work is taking place
  - Upstream DSLT of where work is taking place and then any other DSLT in active work area


Work Area
Only 2 DSRT would be on for this operation, where the work is taking place
Concord
Summit
Nashotah
Oconomowoc Lake
Silver Lake
Nagawicka Lake
Buena Vista
Concord Zoo
Joy Park
Western Culvert & Supply
White Stone Community Church
Summit Corners
Annabelle Acres - Labrador Retriever
Genesee Lake Road Park
AMN Epoxy Flooring
Velvet & Tulle Boutique
The Delafield Hotel
Kettle Moraine State Forest - Lapham Peak Unit
Many Roads Clinic LLC
Sierra
Naga-Waukee Park
Western Lakes Golf Club & Event Venue
THE ORCHARDS OF OCONOMOWOC
RIVERKNOLL
HIDDEN RIDGE
HERITAGE HEIGHTS
LAKE COUNTRY ESTATES
LAKE COUNTRY INDUSTRIAL PARK
Nixon Park
HARTRIDGE
RIVER RESERVE
STILLMEADOW
FOXWOOD ESTATES
OAKWOOD FARMS
ST JOHNS ON THE LAKE
GOLF HILLS
HIGH RIDGE
THE ARBORS
HAYBURN HEIGHTS
TIMBER RIDGE ESTATES
THE MEADOWS OF DELAFIELD
CHEROKEE WOODS
DOVER BAY
LAPHAM PEAK ESTATES
HIDDEN HILLS ESTATES
THE HILLS OF DELAFIELD
Allen Rd
Valley Rd
Delafield Rd
Nashotah Rd
Oakwood Rd
Main St
Milwaukee St
Maple Ave
Emmuss Rd
N Golden Lake Rd
Concord Rd
Silver Lake St
Willow Glen Rd
Golden Lake
N Shore Dr

Activity #4 - DSRS

- Interstate 43, Waukesha County
- AADT 42,200
- 2 Lanes
- Resurfacing
  - Nighttime lane closures for entire project limits
  - Temp Speed Reduction = 55 mph
  - Project Length = 3 miles
  - Stage 1, I 43 NB, 110 days

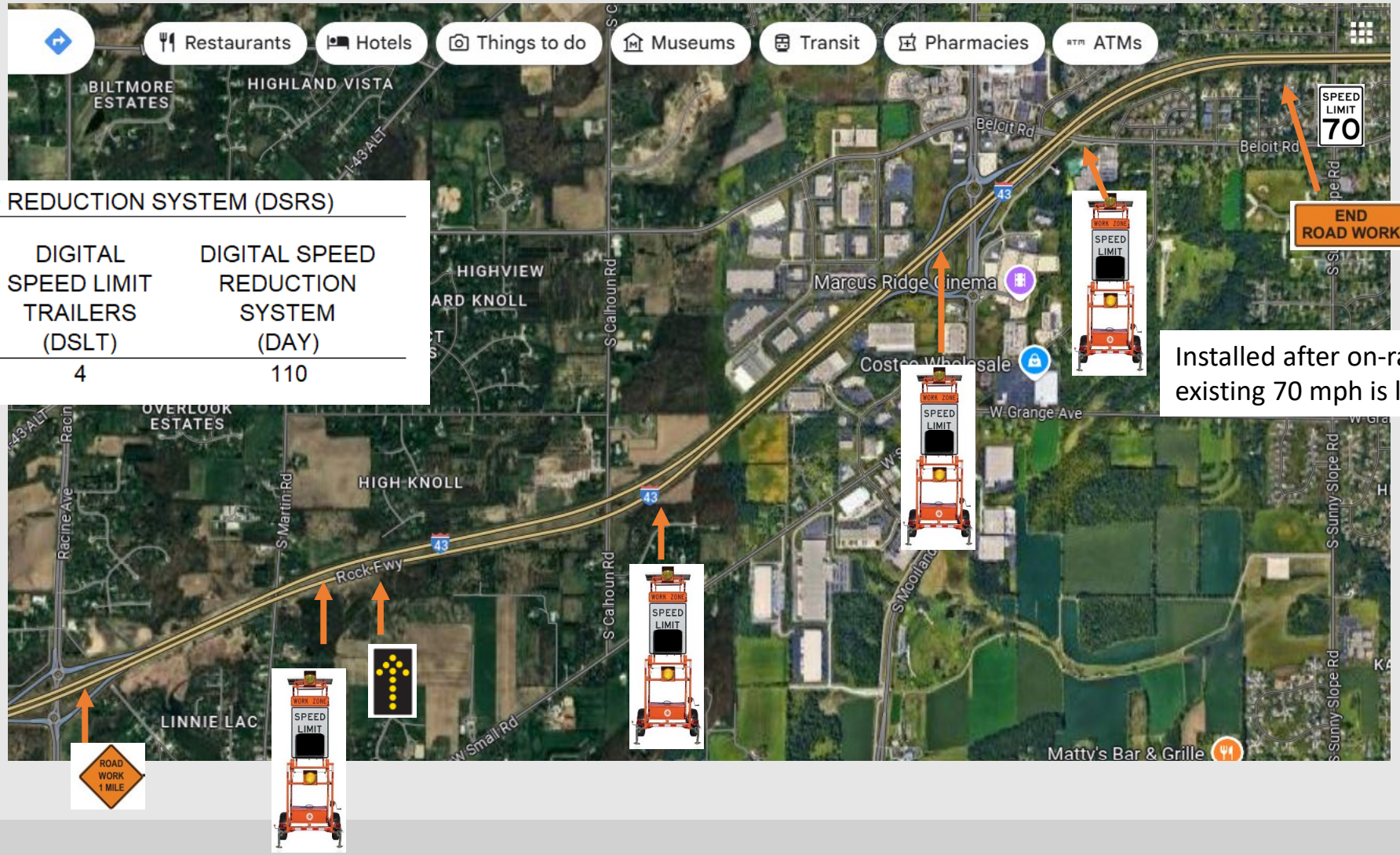
1. Layout DSRS Locations
2. Fill in Misc. Quantities Table

1 tick = ¼ mile

Activity #4 – Solution

DIGITAL SPEED REDUCTION SYSTEM (DSRS)

LOCATION	STAGE	DIGITAL SPEED LIMIT TRAILERS (DSLT)	DIGITAL SPEED REDUCTION SYSTEM (DAY)
IH 43 NB	1	4	110



Installed after on-ramp where existing 70 mph is located

Truck Entering System

- Used 3 times in WI
- Issues with interference with traffic
- Coordinated with work location
- Sensors or cameras
- Used upstream of where trucks are entering the live lane

Other Smart Work Zone Systems

- Speed Wizard
- Temporary Tape Rumble Strips

Presentation/Slides:

Power Point will be posted here:

WisDOT Traffic Operations Training

https://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/programs/training/training.aspx

Questions/Comments

Erin Schwark, erin.schwark@dot.wi.gov

Andrew Heidtke, andrew.heidtke@dot.wi.gov

Survey will be included in the email with the quiz.